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Association of Health Facility Delivery and Risk of Infant Mortality in Nigeria

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This is to certify that the doctoral dissertation by

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Walden University
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Abstract

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MA, Walden University, 2013

BS, Tennessee State University, 1994

Dissertation Submitted in Partial Fulfillment

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Abstract

Infant mortality (IM) incidence in health facility systems during or after infant delivery is substantially high in Nigeria. In this quantitative, cross-sectional study, the effects of skill birth attendants (SBAs), prenatal care, and providers of prenatal care on IM in health facility delivery centers were examined. The Mosley and Chen theoretical framework informed this study and was used to explain the relationship between SBAs, prenatal care, and providers of prenatal care and IM. One hundred and sixty infant deaths were examined among mothers who used an SBA versus those who did not, mothers who had prenatal care versus those without, and mothers who received prenatal care from a health facility versus traditional providers. The 2014 verbal and social autopsy secondary data set was analyzed using binary logistic regression technique. There was no significant difference in risk of IM between mothers who had SBA during infant delivery in health facility compared to those without SBA during delivery. Mothers who received prenatal care had a significant higher risk of infant death in a health facility compared to those that did not receive prenatal care. Mothers who received prenatal care from traditional providers did not have a statistically significant risk of IM compared to mothers who received prenatal care from a health facility. The findings could have positive social change implications by encouraging multilevel public health stakeholders to support and promote the use of health surveillance in understanding the barriers and challenges of health facility delivery practices, prenatal care, and use of SBA as it relates to IM to facilitate policy change in maternal and infant care practices in Nigeria.

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Dedication

I would like to dedicate this research to my little brother, Didacus, who inspired and supported me throughout the PhD processes. I would not have begun such a demanding and life-long learning journey without my entire family. I give special thanks to my husband, our four children, siblings, and well-wishers for their unending support.

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Chapter 1: Introduction to the Study

Introduction

The purpose of this current study is to assess what determinants or risk factors are associated with the increased IM in health facilities. The current inquiry being explored was based on the identified gap in a study by Stanley, Huber, Laditka, and Racine (2016). According to Stanley et al., high risk of deaths among infants in their first year of birth persist in Kenya, Sierra Leone, and Ghana. A high proportion (70.7%) of mothers with recent childbirths who had a health facility delivery with the presence of healthcare provider at labor and delivery had higher IM compared to those that delivered at home without qualified health-care provider in Africa (Stanley et al., 2016). According to World Health Organization (WHO, 2015), skilled birth attendant refers to healthcare-providers such as doctors, midwives, or nurses with formal knowledge, skills and training to provide pregnancy care, child delivery, and postpartum (childbirth) care to mothers and newborns. On the other hand, a nonskilled attendant (e.g. traditional birth attendants [TBAs] such as friends or family members) has no formal education to assist a pregnant woman during labor and child deliveries (Feyissa & Genemo, 2013).

With this current study, the potential positive social change that can be achieved in Nigeria include (a) Strengthening community-based awareness for antenatal care attendance for women during pregnancy up to four or more times to reduce risk of pregnancy-associated complications to IM during childbirth delivery, (b) Advocating public health programs approaches for social capital (social support) where pregnant women share experiences, information, and transfer knowledge among one another in a culturally competent manner, (c) Promotion of maternal care linkages for transportation, nearness to clinics, access to pharmaceutical stores, and midwife/SBA care among vulnerable pregnant women in the rural areas, and (d) Provision of risk-reduction information to policy makers to assist in the development of policies promoting free pregnancy care to postdelivery and newborn or child healthcare to children. Chapter 1 of the dissertation will cover detail information on the background, problem statement, purpose of the research, research questions and hypotheses, theoretical framework, nature of the study, definition of terms, assumptions, scope and delimitations, limitations, and significance of the study.

Background of Study

Stanley et al. (2016) examined the correlation of birth location, type of birth attendants, and IM (death of a 1-year old child) risk in sub-Saharan Africa region (Sierra Leone, Kenya, and Ghana). About 3% of women who were assisted by SBA in health-based deliveries had higher odds of IM compared to those performed by traditional birth attendant (Stanley et al., 2016). However, many researchers demonstrated a positive and protective effect in reducing infant death rates with health facility delivery compared to home-based childbirth (Austin et al., 2014; Berhan & Berhan, 2014; Bohren et al., 2014; WHO, 2014). In contrast, others suggested an increasing rise in the IM in Africa and thus suggested further examination of the problem (Akinyemi, Bamgboye, & Ayeni, 2013; Lawn et al., 2014; Sartorius & Sartorius, 2014).

In 2012, infant deaths decreased by 27%, while childhood death-declined by 67% (Austin et al., 2014). Globally, IM prevalence is about 40% (Lawn et al., 2014; Singh et al., 2014; United Nations Inter-agency Group for Child Mortality Estimation [UNIGCME], 2015). Other findings suggested a higher percentage of IM to about 44% worldwide in 2015 (Bhutta & Black, 2013; Dahiru, 2017, Lawn et al., 2014). Health determinants such as lack of quality care during delivery, antenatal care (ANC) and services (pregnancy education and counseling), and low number of ANC visits are common risk factors of early neonate deaths (Agyepong et al., 2017; Akinyemi et al., 2013; Kananura et al., 2016; Dörnemann et al., 2017; Koffi, Libite, Moluh, Wounang, Kalter, 2015; Patel & Ladusingh, 2015).

The high proportion of deaths among infants spanned across low-income and middle-income countries (LMICs) (Chou, Daelmans, Jolivet, Kinney, & Say, 2015; Corsi & Subramanian, 2014; Dörnemann et al., 2017; Lawn et. al., 2014; UNIGCME, 2015). Dörnemann et al. (2017) reported 2.7 million neonate deaths worldwide. The findings supported previous studies reflecting a high IM prevalence (Kananura et al., 2016; Liu et al., 2015). The infant mortality rate (IMR) was not only high, but consistently higher compared to childhood death rates (Kananura et al., 2016). According to Kananura et al. (2016), of the 8.2 million recorded deaths of those under 5 years r, 3.3 million cases were neonates. The neonates’ mortality report was higher than the estimate reported by Dörnemann et al. (2017). Of 3.3 million infant deaths in 2015, 1.2 million occurred in sub-Sahara regions of Africa (SSA) regions alone (Kananura et al., 2016). The estimate unequivocally confirmed high disproportionate burden of IM across nations, especially in African continent or sub-Sahara African region.

Approximately 47% reduction in neonate death occurred worldwide from 1990 to 2015 compared to 53% decrease in death among children under five (Dahiru, 2017). However, the success in the IM reduction affected mostly the upper-middle income countries (Moyer & Mustafa, 2013). Unfortunately, the low-income countries have the highest risk of infant and child mortality cases (Moyer & Mustafa, 2013). Fewer infant deaths in advanced countries are likely due to availability and accessibility of maternal and childcare services, and high utilization of the services (Tura, Fantahun, & Worku, 2013). As a result, better pregnancy outcomes in the healthcare-facility delivery in high-income countries have occurred and thus facilitated synergistic effect in the reduction of neonatal death rates compared to LMICs (Tura et al., 2013). In contrast, developing countries have less high-quality healthcare systems, amenities, and less high-technology structures with most of the population living under low socioeconomic status (WHO, 2015). Governance, infrastructure, and standardized quality care for mother and child services is problematic in many areas in developing countries (WHO, 2015). According to researchers, multilevel factors are associated with IM in LMICs including cultural norms, poor-quality maternal and child care practices, infection, parity, mother's age, care-seeking behavior, coverage, supplies, infrastructure, equipment, intrapartum, and premature complications (Moyer & Mustafa, 2013). Also, variation in attributable risk factors exists across countries, nation, and regions as well (Moyer & Mustafa, 2013).

Preventable labor and delivery complications accounted for many deaths among pregnant women and newborns (Kananura et al., 2016; Lawn, Davidge et al., 2013). In 2015, maternal mortality specifically those linked to pregnancy, labor, and delivery, including 42 day-postdelivery was 303, 000 globally (WHO, 2015). The mortality risk of an infant increases with the death of the infant's mother (maternal mortality) (Say et al., 2014). The loss of a mother to birthing is a huge burden to a family, both to health status and social well-being of the child (Say et al., 2014). Delivery complications such as prolonged labor (lasting from 12 to 24 hours), extended bleeding, and puerperal sepsis (infection occurring in childbirth) are associated with 73% of maternal mortality (Say et al., 2014). Direct obstetric complications are life threatening and need emergency obstetric interventions (Say et al., 2014). Labor and delivery stages are crucial periods in which unpredictable obstetric complications could occur and possibly lead to elevated mortality risks in pregnant women and unborn child (Demissie, Dessie, Michael, Kahsay, & Tadele, 2015; Hailu & Berhe, 2014).

The relationship between maternal and newborn's mortality provided the evidence-based foundation for the need of SBA presence during labor and delivery (Kananura et al., 2016). The absence of SBA during childbirth is a primary indicator of the high incidence of infant death (WHO, 2015). SBA presence during labor or delivery is a core measure in maternal and childcare and, when used appropriately, could stabilize obstetric complications during emergency situations (Singh et al., 2014). SBAs have the necessary skill set to provide crucial life-saving medical interventions in the absence of physicians (Singh et al., 2014). SBA interventions, particularly in life-threatening complications during labor, are protective (Singh et al., 2014). Also, SBA services provided in a healthcare-facility during adverse pregnancy complication situations have saved newborns and their mothers, especially at clinics where adequate infrastructure is available (Tura et al., 2013). Appropriate and enough infrastructure include running water, sanitized and clean delivery wards, equipment, medical supplies, toilet systems, sufficient and qualified staff, and basic emergency obstetric care services (BEmOC) or comprehensive emergency obstetric care (CEmOC) (Tura et al., 2013).

Most African countries have not met the post-2015 Millennium Development Goal-4 established in 2002 intended to reduce IM by 75% (UNIGCME, 2015). The high burden of maternal and IM is prevalent in developing countries (UNIGCME, 2015). It appears that it is only through research findings, policy changes, and tailored interventions can adequate reduction in the neonatal death rate in SSA be achieved. Specifically, SSA have high rate of IM (Singh et al., 2014). The health facility is a place where formal trained and competent health professionals such as nurses, midwives, doctors, and other health practitioners, including SBA perform childbirth delivery or care for pregnant women in labor (Austin et al., 2015; Islam, Islam, & Yoshimura, 2014; Mangeni, Mwangi, Mbugua, & Mukthar, 2013; Moyer & Mustafa, 2013; Sambo & Kirigia, 2014; WHO, 2015). In situations where child delivery becomes life-threatening or obstetric complication occurs, SBA are trained to quickly and appropriately address the medical needs of the patient while considering the seriousness of the emergency (Okigbo & Eke, 2015). From medical perspectives, the use of SBA could reduce the rate of infant fatality related to complications during childbirth deliveries, which could promote better childbirth outcomes and the quality of life (United Nations International Children's Emergency Funds [UNICEF], 2015). However, in SSA, IM is higher in a health facility (a hospital delivery facility) than at-home delivery where in most cases, nonformally trained childbirth delivery practitioners such as mother-in-law or friends assist in child delivery (Stanley, Huber, Laditka, & Racine, 2016). In other words, infants born at home either with or without the assistance of nonformal birth attendants have lower death risk than those delivered in the health facility (Stanley et al., 2016).

A nonskilled attendant has no formal education to assist a pregnant woman during labor and child deliveries (Feyissa & Genemo, 2013). Based on the formal operational definition of maternal, pregnancy, and delivery care, a nonformal skilled attendant may not provide adequate care to mothers, pregnant women or newborns in an obstetric life-threatening complication (Austin et al., 2015; Feyissa & Genemo, 2013; Mangeni et al., 2013; Islam et al., 2014; WHO, 2015). Such obstetric complications are inherent in labor and delivery (Austin et al., 2015; Feyissa & Genemo, 2013; Mangeni et al., 2013; Islam et al., 2014; WHO, 2015). The fundamental differences between SBA and TBA in terms of the operational, construct, and application purposes could play a crucial role in maternal and IM rates within the health facility delivery systems in Nigeria. The out-of-hospital birth delivery approach could increase the risk of child or maternal death in cases where unpredictable emergency complications occur before, during, and after child delivery (Shiferaw, Spigt, Godefrooij, Melkamu, & Tekie, 2013). For example, SSA is only 12% of the global population, yet has substantial maternal and neonatal deaths (Gitimu et al., 2015). Overall, child births performed with the assistance of SBA were lower in number compared to the total number of women who attended prenatal cares (Gitimu et al., 2015).

In other studies, health facility delivery was shown to produce better pregnancy outcomes such as reduced IM and mortality worldwide (Austin et al., 2014; Berhan & Berhan, 2014; Bohren et al., 2014; WHO, 2014). Within individual in LMICs such as South Asian and African nations, many cases of births in health institution or facilities were fatal (Stanley et al., 2016). Disproportionately, developing countries had higher IM rate (IM rate or neonatal mortality rate [NMR]) compared to the death rate in the health-institution delivery in the advanced countries (Kananura et al., 2016; Sartorius & Sartorius, 2014; UNICEF, 2015; Wang et al., 2014). According to Wang et al. (2014), IMR estimates in 2013 were 1.2 per 1,000 live births in Singapore. On the other hand, the IMR in Mali in the same year was 42.6 per 1,000 live births (Wang et al, 2014). In developing countries, the IMR varies across countries, nations, regions, geographic locations, and urban or rural areas (Wang et al., 2014). In Guinea-Bissau, the IMR was 152.5 per 1,000 live births, while in Nigeria and India, 105 per 1,000 and 42.5 in 1,000 livebirths respectively were reported (Wang et al., 2014).

Furthermore, in LMICs, one out of every 12 children born alive dies before the age of 5 years old or within the fifth birthday compared to one in 147 children born in advanced countries (UNIGCME, 2015). The in-health facility in Nigeria reported persistent high infant deaths (Ekwochi et al., 2014). Many other countries in SSA have low neonatal annual rate reduction and high IMR than developed countries (Sartorius & Sartorius, 2014; Wang et al., 2014). In another study, the health facility NMR reported in Nigeria was 124 in 1,000 live births, 182 per 1,000 live births in Sierra-Leone, and 128 in 1,000 live births in Mali (Agyepong et al., 2017). Based on reported high incidence and prevalence of IM, IMR, and NMR in Nigeria compared to low rates observed in developed countries, the need to conduct this study is warranted.

Due to the observed small improvement of IMR reduction in most developing countries, SBA effectiveness in home delivery has not been established on whether it could promote a safe motherhood as in the health facility settings during delivery, and postdelivery. In developing countries, majority of pregnant women deliver outside health facility (Cheyney et al., 2014). As such, if unpredictable emergency complications occur in the home-based delivery settings, at least SBA can provide interventions to stabilize life-threatening conditions to reduce adverse health events or death that could affect the mother or the child so that a safe transfer of the patient(s) to emergency obstetric care is ensured (Cheyney et al., 2014). In SSA, IM associated with home deliveries in the absence of formal skilled attendants during childbirth has not been well studied (Liambila & Kuria, 2014). To this effect, in this current study, the association between SBA and infant deaths within health facility in Nigeria compared to home delivery was explored.

Problem Statement

The overall health status of children and mothers reflect the general population health outcomes. A child health status is determined by the type of care (access and availability of appropriate and adequate prenatal care) the mother receives before and during pregnancy period, and health care provided during and after childbirth (Sartorius & Sartorius, 2014). According to the WHO, appropriate maternal care involves access and adherence to the recommended prenatal care of four visits or more, and skilled attendant present at labor and during child delivery (Afulani & Moyer, 2016; Islam et al., 2014; Okigbo & Eke, 2015). Based on the WHO (2015) recommendation, the skilled attendant could prevent and reduce possible morbidity and mortality incidence associated with child delivery. For instance, the presence of a skilled birth attendant during delivery could prevent or revert adverse health outcomes in pregnancy-related complications such as excessive bleeding (Akinyemi et al., 2013; Anastasi et al., 2015; Singh et al, 2014).

Among newborns, intrapartum (labor) and premature birth complications accounted for most deaths especially during labor and delivery events (Bhutta & Black, 2013). Increased neonatal deaths were associated with health facility delivery (Moyer, Dako-Gyeke, & Adanu, 2013). However, the finding has not been investigated in most African countries, particularly in Nigeria (Moyer et al., 2013). The global neonatal annual death reduction rate (ARR) from 1990 through 2012 was 2.0% (Lawn et al., 2014). The neonatal ARR is smaller compared to 3.4% estimate for infants' ages between 0-4 years old within the same period (Lawn et al., 2014). The low global neonatal ARR of 2.0% is indicative of the little progress achieved thus far in mitigating the preventable and amenable cases of high incidence and prevalence of IM in developing countries (Lawn et al., 2014; UNICEF, 2015). The observed high incidence and prevalence of IM, IMR, and NMR in Nigeria supports the need for further investigation on this issue.

Perhaps to address some of the health issues or risk factors associated with maternal health and IM, Stanley et al. (2016) suggested that "further research is needed to determine why delivery at a health facility would be associated with an increased risk of IM" (p. 7). In other words, Stanley et al. (2016) found increased risk of child delivery in health facility in their study but the scope of their study did not address the determinants or risk factors associated with the increased infant deaths, observed. Thus, they suggested perhaps that more academic research or program-driven studies should explore the factors associated with increase IM in health facility (Stanley et al., 2016). The gap identified by Stanley et al. (2016) also supported the need for urgent public health interventions and health promotion measures among the at-risk target population to mediate the disproportional health burdens of IM as proposed by Lawn et al. (2014). Therefore, to explore the identified gap by Stanley et al. (2016) in health facility delivery, I investigated the following risk factors: SBA presence or absence, seeking prenatal care during pregnancy, and the entity who provided the prenatal care (health facility provider [hospital, nongovernmental organization (NGO), governmental clinics, private clinics, community nurse or midwife facility] or traditional provider [TBA, quack, village doctor, relative, neighbor, friend, and other nonformal or traditional provider]).

Purpose

The purpose of this current study is to assess what determinants or risk factors are associated with the increased IM in health facilities. In this current study, the determinants or risk factors that were explored in relation to its effects on IM in health facility are SBA presence or absence, seeking prenatal care during pregnancy, and the agency providing the prenatal care. The target location for this study was Nigeria and the target population was women who lost a child during delivery or after delivery. The lost infant must be under the age of 1 year.

To explore the effects of SBA presence or absence during delivery in health facility on IM, infant deaths among women who delivered with the assistance of SBA was compared to those women that gave birth to a child in the absence of SBA help. To examine the effects of prenatal care during their pregnancy, I conducted a comparative assessment on the number of IM cases among women who had prenatal care visits and those who did not have prenatal care. Similarly, to investigate the influence of the entity who provided the prenatal care, a comparative evaluation on the number of IM cases was performed among women who received their prenatal care from a health facility against those who were provided prenatal care by a traditional provider before the delivery that occurred in a health center or clinic. For all the three comparative assessments specified, I used a quantitative approach to evaluate the difference if any in the IM cases of newborn deaths in Nigeria among the selected target population. The findings from the study inquiry informed necessary several areas of SBA care and services, the need for prenatal measures, and the relevance of the entity or practitioners who provide maternal or prenatal care.

A greater understanding of how maternal health conditions through prevention and treatment of ill health could influence risks of disease and IM outcome. The needs for development of programs that will promote the reduction of infant deaths in the community is warranted as the effects of determinants (SBA presence or absence, prenatal care, and entity providing prenatal care) on increased IM in health care facilities has not been adequately evaluated in SSA regions (Stanley et al., 2016). Therefore, in developing countries, particularly Nigeria, through this study, an immense body of knowledge advanced meaningful health promotion measures to address the persistent high IM observed in the health facility delivery systems within the region. Promoting proper data collection on maternal, births, and deaths' registry in SSA regions can advance evidence-based policy development, preventive measures, and intervention programs on this issue as well (Bhutta & Black, 2013).

Research Questions and Hypotheses

RQ1: What is the difference in risk between IM in health facility for infant delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA?

$H_0$1: There is no difference in risk between IM in health facility for infant delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA.

H_a1: There is difference in risk between IM in health facility for infant delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA.

RQ2: What is the difference in the risk of IM between infants born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy?

$H_0$2: There is no difference in the risk of IM between infants born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy.

H_a2: There is difference in the risk of IM between infants born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy.

RQ3: What is the difference in the risk of IM between infants born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the infant delivery in the health facility?

H_03: : There is no difference in the risk of IM between infants born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the infant delivery in the health facility.

H_a3: There is difference in the risk of IM between infants born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the infant delivery in the health facility.

Theoretical Framework

Mosley and Chen’s (1984) theoretical or analytical framework was the theoretical basis for this current study. Mosley and Chen's theoretical framework was used to explore proximate factors influencing infant's mortality through biological mechanisms (Mosley & Chen, 1984). The mechanisms through which infant's health status is affected by the disease processes and deaths are linked to the mother's health characteristics and status (Mosley & Chen, 1984). As a result, mother's health determinants operate through biological factors to promote or reduce injuries and death among vulnerable infants (Adedini, Odimegwu, Imasiku, Ononokpono, & Ibisomi, 2015). In other words, a mother's health status affects newborn's survival rate, injury outcomes, and death. The health determinants are proximate factors because they can only operate among children in poor resource settings through their mother's biological characteristic profiles.

The Mosley and Chen (1984) model was developed to clarify the understanding of the factors influencing family production of healthy children to inform health policies and structures. Mosley and Chen merged the traditional social scientist approaches with the medical researchers' concepts. The socioeconomic determinants are the foundation of the Mosley and Chen model (Mosley & Chen, 1984). The socioeconomic determinants are grouped into five proximate factors, maternal, environmental contamination, nutrient deficiency, injury, and personal illness control (Mosley & Chen, 1984). The maternal factors include personal characteristic such as age, birth interval, and parity (Mosley & Chen, 1984). The environmental contamination involves extrinsic factors such as the food, water, air, soil, pest, inanimate object, and skin (Mosley & Chen, 1984). Nutrient deficiency includes vital elements such as minerals, vitamins, proteins, and calories (Mosley & Chen, 1984). Injury determinants include accidental and intentional factors (Mosley & Chen, 1984). Personal illness control involves preventive measures and medical treatment/intervention, see Figure 1 (Mosley & Chen, 1984).

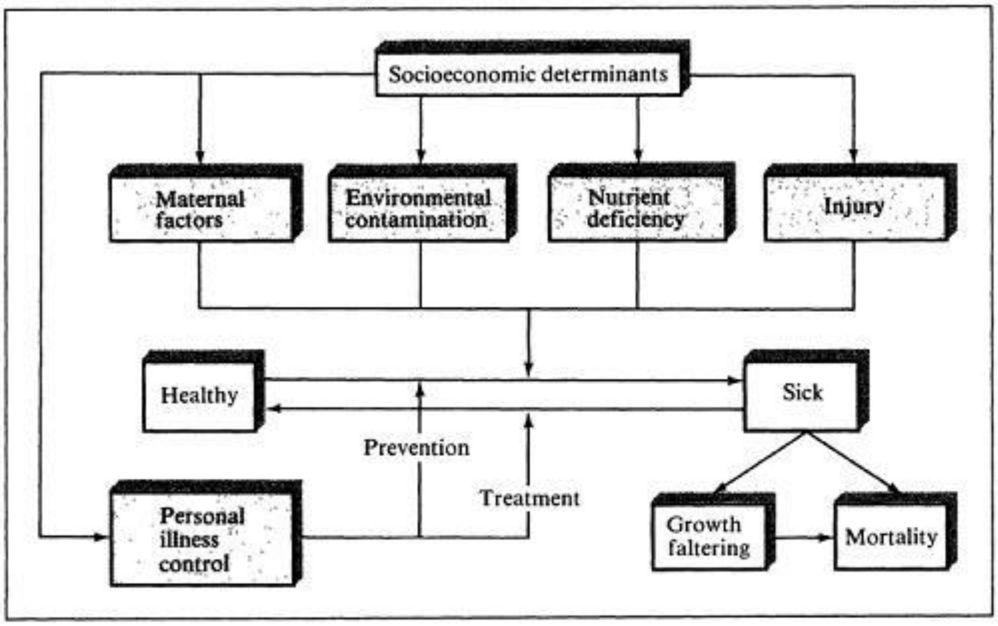

Figure 1. An analytical framework for the study of child survival in developing countries (Source:https://pdfs.semanticscholar.org/6496/a83bd5f0d023f9a5437 e62cfd3d14351 85e5.pdf)

A common health indicator associated with some proximate factors is small-for-gestational age (SGA) or low birth weight ([LBW] of less than 2lb, 500g or 2.5 kg) (Dahlui, Azahar, Oche, & Aziz, 2016; Lawn et al., 2014). For example, LBW risk outcome has been linked to maternal malnourishment and infections, which could lead to preterm complications (Dahlui et al., 2016). Annually, 18 million LBW neonates are born, globally (Dahlui et al, 2016). In Nigeria alone, over 5 million infants are born with LBW, yet these cases are preventable (Dahlui et al, 2016). The analytic framework of infant survival in LMICs advances the understanding of how socioeconomic, culture, and environment influence proximate health determinants that affects child survival or mortality in poor settings (Mosley & Chen, 1984). Therefore, beyond the proximal determinants, the application of Mosley and Chen theoretical concept account system factors such as micro, macro, and personal level components to improve women health, especially during pregnancy, delivery, and post childbirth.

In this current study, the application of the Mosley and Chen (1984) theoretical framework was used to explain the effects of SBA, prenatal care, and providers of prenatal care to IM or infant death cases, which in this study,was the dependent variable (DV) in each of the three posed research questions. The common exposure route to SBA, prenatal care, and providers of prenatal care is through routine visits to the health facility during the pregnancy period. The SBA presence or absence, prenatal care or no prenatal care, and providers of prenatal care [health facility or traditional provider], could either produce a positive or negative or neutral association or effect on IM or infant death cases. In this current study, the *injury* determinant was used to explain infant death cases or IM. SBA, prenatal care, and providers of prenatal care was explained using the *personal illness control* determinant. Diabetes and hypertension are covariates or confounding variables and was explained using the *nutrient deficiency* determinant. Also, the influence of education level (another covariate or confounding variable in this study) to health outcomes or quality of life was explained using the *maternal* factor. Diabetes, education level, and hypertension are known confounders that influence pregnancy outcomes (National Population Commission (NPC) Nigeria and International Classification of Functioning, Disability and Health (ICF), 2014). The synergy of social, economic, biological, and environmental determinants could influence health outcomes through proximal variables such as nutrition and disease processes, which could affect morbidity or mortality cases among infant in developing countries (Adedini et al., 2015; Mosley & Chen, 1984). The criteria used for the application of Mosley and Chen's (1984) theoretical framework are as follows:

- Newborns are expected to survive under optimal conditions that are not limited to the health status of the mother.
- Social and economic predictors operate through proximate determinants to influence infant and child mortality. Hence, a single disease factor is an inadequate variable for associated risk of death.
- Nutrients deficit and disease conditions are examples of proximal variables operating through biological mechanism to influence infant and child mortality or produce adverse health outcomes such as prematurity of birth and low birth weight among others.
- Infant and child mortality or survivability are associated with multiple risk factors (biological, environmental, social, and economic components). Disease risks or indicators affecting infants must go through biological pathways to influence injury or death.
- Maternal care-seeking behavior (preventive and treatment) measures may limit disease exposure and injury risks if applied appropriately.

Nature of the Study

The nature of this study is a correlational observation in which a quantitative research method was used. The research design I used was a cross sectional approach. In the study, I explored the effects of SBA presence or absence, prenatal care, or no care during pregnancy, and the entity who provided the prenatal care (health facility provider [hospital, NGO, governmental clinics, private clinics, community nurse or midwife facility] or traditional provider [TBA, quack, village doctor, relative, neighbor, friends, other nonformal or traditional provider]) on IM cases in a health facility. The data used for this study analysis was secondary dataset (from the 2014 Verbal and Social Autopsy [VASA]) dataset, which was produced from the 2013 Nigeria Demographic Health Survey (NDHS). The 2013 NDHS data preceded the VASA data collection (Loveth et al., 2016). The 2014 VASA dataset for children under 5 years of age containing information about IM estimate was used for the analysis.

The 2014 VASA survey was administered to women who participated in the 2013 NDHS study (those that lost a neonate or child in the household preceding the 2013 NDHS study (NPC & ICF, 2014). A randomly selected sample of 2,944 out of 3,254 households that completed the questionnaire survey was included in the VASA study (Koffi et al., 2017). The primary purpose of VASA is to gather specific health characteristic profiles or indicator information regarding the social determinants and causes of death and social factors influencing children under the age of 5 years old in Nigeria (NPC & ICF, 2014). VASA’s IM survey was a first of its kind in Nigeria. The estimated IMR from the VASA study suggested that 69 cases of infant deaths per 1,000 live births occur in Nigeria in 2013 (NPC & ICF, 2014). Meanwhile, the 2015 postera Millennium Development Goal (MDG-4) target goals was to reduce the under five mortality rate (U5MR) worldwide by three quarters (75%) by 2015 (WHO, 2015). Unfortunately, the Nigerian U5MR is relatively too high. Hence, the chances of achieving SDG-3 in high U5MR countries is slim. Nigeria must continue to promote evidence-based health measure (EBHM) and evidence-based intervention (EBI) in identifying regional, geographical, social determinants, and cause-specific attributes of IM risk factors through research (qualitative and quantitative approaches) and tailor such findings appropriately to programs and intervention approaches to reduce high NMR. It appears that several intervention approaches to reduce under fivedeaths are currently evolving in other African countries such as Cameroon, Niger, and Malawi (Koffi et al., 2015). The improvement reached in addressing many of the determinants of child mortality in West and Southeast of Africa suggests the need to substantially reduce the prevalent cases of under five deaths in developing countries (Koffi et al., 2015). I used a binary and binomial logistic regression model to address the research questions and hypotheses posed (the association between health facility delivery with the presence or absence of SBA, prenatal care or no prenatal care, and provider of prenatal care [health facility provider or traditional provider] and IM) in Nigeria.

Definitions

Antenatal or prenatal care: Health care services provided by SBA comprising of health education and counselling to pregnant women (Acharya et al., 2015; Demissie et al., 2015). Such health interventions approach includes childbirth preparations, complications risk reductions, wellness, and treatment during antenatal visits (Acharya et al., 2015; Demissie et al., 2015). Postdelivery breast-feeding education health coaching are covered as well during antenatal care (Acharya et al., 2015; Demissie et al., 2015).

Diabetes: A chronic disease that affect blood vessels that is associated with IM or maternal mortality (NPC & ICF, 2014). Diabetes is a covariate included in the 2014 VASA data (NPC & ICF, 2014).

Health facilities: A place healthcare providers such as trained SBAs, nurses, medical practitioners provide healthcare services including maternal and childcare (pregnancy, childbirth, and postpartum care) (Sambo & Kirigia, 2014). In this study, health facility or health institution include, but are not limited to, maternities, community centers, health-posts, hospitals, and tertiary centers.

Health facility delivery: Child birthing which occurred in health facility or health institution (Stanley et al., 2016). Also, transferred-health facility child delivery occasionally occurs whereby pregnant women whose labor and delivery may have started outside of the health facility system are transported to the health facility for child delivery (Stanley et al., 2016).

Health facility provider: A formal entity or health professional that provide prenatal and postnatal health care services to pregnant women and mothers and their new born child (NPC & ICF, 2014). The entity employ staff who have a formal education on prenatal and postnatal care (NPC & ICF, 2014). Examples of health facility provider are hospital, NGO health practitioners, government clinics, private clinics, and community nurse or midwife facilities (NPC & ICF, 2014).

High blood pressure: This is a medical condition referred to as hypertension, which may lead to a chronic disease (Say et al., 2014). In some pregnant women, it could lead to pregnancy-induced hypertension, which leads to eclampsia condition and a risk factor to IM (Say et al., 2014).

Home delivery: Child delivery at home or in a nonhealth care facility and by a nonskilled attendant such as TBA, mother-in-law, friend, or any other individuals who have no formal training to perform childbirth (Feyissa & Genemo, 2013). In SSA, most of the pregnant women deliver a child outside health facility (Habte & Demissie, 2015).)

Intrapartum complication: Pregnancy labor and delivery complications. SBA presence during childbirth is necessary because, with a severe complication case, many newborn deaths occur at child delivery (Lawn et al., 2014; WHO, 2015).

Infant: Infant is defined as someone younger than 1 year old (Adedini, 2015).

Infant mortality: Death of infant less than 1 year old (Adedini et al., 2015).

Low birth weight: Neonate with body weight less than 2.5 kg or 2500 grams at birth (Lawn et al., 2014). Neonates with low birth weight have a high risk of disease infection, morbidity, and mortality (Lawn et al., 2014).

Neonates: The age range of infants or neonate is 0-28 days old in this study. Neonate is defined 0-28 days or first month of life (Bhutta & Black, 2013; Kananura et al., 2016; Mason et al., 2014; NPC & ICF, 2014; Wardlaw, You, Hug, Amouzou, & Newby, 2014). However, the VASA data, secondary data source defined neonate as 0-27 days old (NPC & ICF, 2014).

Neonate or newborn mortality: Death-incidence among newborns (0-28 days old) either within or outside the healthcare facilities (Stanley et al., 2016).

Obstetric or life-threatening complications: Unexpected labor and child delivery related to profound bleeding, eclampsia (pregnancy-induced high blood pressure), convulsion, high fever, obstructed or prolonged labor (lasting 12 to 24 hours), and placenta rupture (Demissie et al., 2015; Hailu & Berhe, 2014). Obstetric complications usually require emergency obstetric care to prevent mortality outcomes.

Preterm birth: Birth delivery earlier than 38 weeks of gestational age (Lawn et al., 2014; Mason et al., 2014).

Pregnancy complications: Nonlife-threatening complications during pregnancy and delivery that requires SBA care (Demissie et al., 2015; Hailu & Berhe, 2014). For example, infection, blurred vision, minor vaginal bleed, swelling of hands and feet (Mbalinda, Nakimuli, Kakaire, Osinde, Kakande, & Kaye, 2014).

Safe motherhood: Global initiative recommended for child delivery assisted by SBA (Islam et al., 2014; WHO, 2015). Child delivery assisted by SBA is a preventive and protective measure to reducing IM (Mangeni et al., 2013; Moyer & Mustafa, 2013; UNICEF, 2015). When life-threatening or obstetric complication incidences occur during child delivery, SBAs timely interventions could reduce cases of IM (Islam et al., 2014).

Severe bleed: The occurrence of sever bleed or hemorrhage is where substantial amount of blood is lost during pregnancy, delivery, and postchildbirth posing a high risk for maternal or infant death (Hailu & Berhe, 2014; Henok, 2015; Say et al., 2014).

Skilled birth attendant: A healthcare provider such as a nurse, midwife, and physician with formal knowledge, skills, and training to provide pregnancy care, child delivery, and postpartum (childbirth) care to mother and newborn (Austin et al., 2015; WHO, 2015).

Stillbirth: Death of fetus in the womb or at point of delivery (Lawn et al., 2014).

Tarok: It is a town comprising four communities in Platau State, Nigerian (Orisaremi, 2013). The pregnancy care and childbirth behavior and practices of the women of Tarok community is greatly influenced by the social-cultural norms (Orisaremi, 2013).

Traditional provider: A nonformal entity or individuals that provide prenatal postnatal care services to pregnant women (NPC & ICF, 2014). They do not have formal education on prenatal and postnatal care (NPC & ICF, 2014). Examples of traditional providers are TBA, quack, village doctor, relative, neighbor, friend, and other nonformal or traditional provider (NPC & ICF, 2014).

Under-5 mortality: Death of children under 5 years of old (0 to <5 years old) (Dahiru, 2017; WHO, 2015).

Under-1 mortality: Death of infants under the age of 1 year of old (0 to <1-year-old) (Dahiru, 2017; WHO, 2015).

Assumptions

About two-thirds of pregnant women in SSA countries such as Nigeria deliver their newborns at home rather than in health facility where SBAs supervision are provided and available to assist labor and child delivery (Habte & Demissie, 2015; Pasha et al., 2013). It is uncertain whether low number of infant deaths at home delivery is due to underreporting of the cases. It is not also clear whether the paucity of birth and death registry in developing countries, enough information could not have been provided to make accurate assessment about this phenomenon. Inadequacy or absence of quantitative research findings on IM in SSA could contribute to the lack of the knowledge (Lawn et al., 2014).

With enough data collection on IM cases in both health care facility, infant deaths related to child delivery could in full extent be evaluated. Preventable infant deaths in the presence of SBA within the health facility with optimal delivery infrastructure could save lives than would be possible at home-childbirth (Altman, Sidney, De Costa, Vora, & Salazar, 2017; Chinkhumba et al., 2014; Tura et al., 2013). Though, this assumption will not be tested or evaluated in this study. As it stands, IMR in health facility delivery is higher than in the home-child delivery in developing countries (Stanley et al., 2016; Fadel et al., 2015). In contrast, fewer IM occur in the home-child delivery than observed in the health facility (Kumar et al., 2014).

Another assumption that could not be tested or evaluated in this study is that disparities in IM compared to childhood deaths, and maternal mortality worldwide, especially in developing countries is preventable (Bhutta & Black, 2013; Dahiru, 2015; UNIGCME, 2015). Also, it is assumed that women in SSA have the resources (income and social support) to participate in healthcare facility child delivery. Similarly, it was assumed in this current study that healthcare facilities are readily available and accessible to all pregnant women in SSA regions. The assumptions are important in understanding women needs especially those who prefer home child delivery over the health facility delivery. If the assessment in this current study was appropriately applied, it could advance informed EBHM to promote healthy pregnancy and the need for qualified SBA during labor and child delivery. Interestingly, over half of pregnant women in SSA prefer the assistance of a nurse or midwife at labor or during childbirth (Pasha et al., 2013). However, in most part, due to sociocultural barriers, many pregnant women in SSA do not participate in health facility childbirth (Pasha et al., 2013).

Scope and Delimitations

The scope of IM under investigation was limited to infants under 1 year old within the healthcare facility-based delivery. In this study, the association between IM and SBA present or absent, seeking prenatal care during pregnancy, and the agency providing prenatal care wereexplored. The selected age criteria were defined and operationalized in the VASA data (NPC & ICF, 2014). The purpose of this study was to use the information obtained in this research inquiry to advance health promotion measures in reducing high IM at the first day, weeks or within 28 days or event in long-term neonatal care within healthcare delivery systems. The short- and long-term preventative measures will also support Stanley et al.'s (2016) suggestion on the need to enhance IM reduction measures resulting from child delivery. It appears that in the healthcare facility, the presence of skilled attendants during childbirth is a useful tool in reducing IM in high-burden areas such as Africa and South Asia (Stanley et al., 2016). Arguably, against established facts showing SBA's supervision of childbirth reducing newborn mortality in health institutional deliveries, a paradoxical effect produced was a higher IM rate pattern in LDCs (Stanley et al., 2016). In this current study, a better understanding of the risk of high IM requires the inclusion of infants younger than 1 year old (0 to < 1-year-old). In contrast, women ages 15-49 years old with human immunodeficiency virus (HIV) risks, high risks pregnancy, adolescent pregnancy (<15 years of age) were excluded from the study. The investigative approach applied in this study for the analysis of the 2014 VASA secondary dataset required a quantitative research method. The use of 2014 VASA data generated via a cross-sectional design constituted a study limitation because the data is 4 years old and may not have captured current development and advancements in the child delivery systems both at home and healthcare facilities.

Also, a cross-sectional research design in the absence of an experimental or quasi-experimental study would not be used to infer any causal relationship in this study. Therefore, the current study cannot be used to address any causal implication relating to IM during labor or child delivery. Lack or insufficient vital birth and death registry in most health facility delivery in Nigeria healthcare facilities could distort the accuracy of any observed information originating from this secondary data analysis. However, reliable and valid sources of infant births and deaths and other vital information could be recorded accurately in the medical records. Another delimitation of VASA research is the methodology approach. Because quantitative approach does not capture qualitative measures, subjective experiences were not assessed and evaluated in this current study. Also, a retrospective survey approach was applied in the data collection for the study via a self-reported interview process, therefore, information obtained from the proxy (mother or female siblings present at the time of interview) regarding deceased-infants could be influenced by recall bias.

Limitations

The 2014 VASA observational study and qualitative method approaches have inherent limitations. A common limitation in observational design is the lack of causal inference. A cross-sectional research design lacks clear spatiotemporal sequence in identifying whether the exposure occurred before the outcome event or that the outcome indicators were already present before the exposure. The administered questionnaire contained an in-depth history of circumstances or event, in this case, IM cases and location of child delivery were elaborately captured in the dataset. External validity may be another barrier due to interviewing diseased proxy (female sibling caregiver interviewed in absence of the mother who may be also deceased during childbirth). In this case, obtaining health information from a proxy regarding the condition about the infants' death may not be credible because the proxy may not be familiar with the health condition or early signs and symptoms leading to the adverse health outcome during or after the infant delivery.

For example, proxy may not recognize subtle signs and symptoms that requires prompted medical treatment before the child became severely sick, then, consequently, did not survive. The care-seeking behavior of the proxy may not be adequate, thus may affect generalization of findings. Also, cultural norm impact on care-seeking behavior or social environmental impact may implicate external validity in generalizing infant outcomes. For example, Agyepong et al. (2017) suggested that socioeconomic environment is an impediment to the vulnerable, less advantaged women (those who live in rural community/low-quantile households) seek care-for-sick child in developing countries. For instance, a parent or mother who lives in the rural area where access to transportation to the emergency care-for-sick newborn may hinder survival than those who live in the urban area, likely to access to health institution. Also, rural and urban residence differential is an important component to facilitate or hindrance to care-seeking behavior, especially maternal and childcare services uptake, implicating internal validity.

Significance

Identification of critical specifics on high IM in health facility deliveries in the presence or absence of SBA, prenatal care adherence or lack thereof, and the types of providers of prenatal care in Nigeria could shed light on the level of knowledge deficit and lack of awareness on this issue. Parents, community, and health facility providers currently addressing this health outcome could benefit immensely from the findings. It will also contribute important changes in professional practices, especially other practices that are linked to increased IM in health facility delivery systems or even at home child delivery in Nigeria. Subsequently, policymakers could also use the information presented in this current study to promote and support meaningful health care bills or policies. Rectification and reassessment of the standards of the health facility delivery systems and re-evaluation of the roles and limitations of the SBA care in the provision of maternal and child services in the health facilities could also be addressed effectively.

If any supporting evidence about a negative correlation of SBA, prenatal care, and providers of prenatal care to the increase in IM in healthcare facilities in this study exists, promoting parents' understanding of the importance of skilled attendant presence during childbirth, prenatal care, and providers of prenatal care in any setting will become the crucial health focus in the area of childbirth and maternal health. Such promotion could reduce mother and childbirth-related deaths and perhaps, premature births, labor, and delivery complications. Also, through meaningful culture-specific program implementations in the health facilities, beneficial return on health investment among vulnerable individuals, families, community levels, and other invested stakeholders could advance a positive social change in maternal, neonatal, and obstetrics discipline.

Potential positive social change effect of the study will be an extension of safe-motherhood initiate of SBA presence even at home childbirth among individuals who may choose to deliver at home further to improve safety childbirth. Similarly, awareness on the emphasis of prenatal care and selection of formal prenatal care providers could substantially influence maternal and birth outcomes. Successful implementation of this approach could also influence policy changes based on a measurable evaluation of pregnancy outcomes. Also, it could advance health literacy and health education awareness on safe childbirth and maternal care across the community, nation, and the region at large. Further, the impact of this intervention and subsequent positive or negative findings from this study could increase wide-spread information and knowledge transfer and translation among parents, providers, and public health practitioners especially those in the rural areas that are hard to reach populations.

Summary

While there are mixed or conflicting results on IM rate within health facility-delivery systems in the presence of SBA at childbirth in African nations, further research are needed to explore the rise in the IM in the health facility clinics especially in SSA region (Stanley et al., 2016). Also, high IM in health-institutions in Malawi, southeast Africa aligns with other findings (Koffi et al., 2015). Furthermore, there is slow infant death decline in health facility delivery in southeast compared to southwest and south-south zone Nigeria (Akinyemi et al., 2013; Koffi et al., 2017). Alongside the pattern of high proportion IM in Africa is consistent with previous documentation (Ekwochi et al., 2017; Kayode et al., 2014). Largely, preventable maternal infections, preterm, and intrapartum obstetric/life-threatening complications are the leading factors of IM (Ekwochi et al., 2017; Liu et al., 2015; UNIGCME, 2015).

Despite the overall global high mortality rate for children under 5years, deaths of infants aged 1-month-old (0-28 days old) are persistently high in south Asia and Africa (Akinyemi et al., 2015; Alkema et al., 2014; Lawn et al., 2014; You et al., 2016). Additionally, IM risk differential exists between infant born in private verses public health facilities across SSA regions (Altman et al., 2017; Berhan & Berhan, 2014; Kumar et al., 2014). Also, several researchers suggested that health-institutional child delivery service provided by SBA is effective, protective, and beneficial in reducing IM (Altman et al., 2017; Austin et al., 2014; Berhan & Berhan, 2014; UNIGCME, 2015; WHO, 2014). Unfortunately, SSA region has a reverse consequence of increased newborn mortality rather than decrease in IM in health-institution deliveries, more than in home-based child births (Bohren et al., 2014; Stanley et al., 2016).

Provision of adequate and quality maternal and newborn health care services by SBA in health facility child-delivery systems are needed to substantially reduce the IM prevalence in high burden regions (Bhutta & Black, 2013; Dahiru, 2015; Mitao, Philemon, Obure, Mmbaga, Msuya, & Mahande, 2016). SBA-driven intervention in health facility as well as in home-based delivery systems will substantially reduce the IM rate in developing countries (Islam et al., 2014; WHO, 2015). The key sections of Chapter 2 discussed in detail includes literature search strategy, theoretical framework, and literature review or synthesis.

Chapter 2: Literature Review

Introduction

The growing trend of IM in health facility delivery in developing countries needs urgent attention. Stanley et al. (2016) suggested that further research inquiry addressing IM-related issues should be conducted in Africa, especially in the SSA regions. Based on the observed increase in the pattern of the IM rate, my aim was to explore the association of IM in health facility in Nigeria among women who delivered in the presence or absence of SBA, those that had prenatal care or no care during pregnancy, and the effect of providers of prenatal care (health facility provider or traditional provider). In this section of the dissertation, the literature search strategy, theoretical framework, literature review or synthesis, and summary and conclusions relating to IM were discussed in detail.

Literature Search Strategy

Several databases were used as the search engine sources for articles relating to IM in health facilities, pregnancy, maternal mortality, unskilled or TBAs, and SBAs. Most of the literature reviewed are within a 5-year period starting from 2013 to 2018 except for few published articles which were beyond 5 years old. The articles that were more than 5 years old from the time of its publication to 2018 were mainly literature relating to the Mosley and Chen theoretical model or framework used in this current study. For example, the original article published by Mosley and Chen on analytical framework of infant survival was published in 1984. Many of the databases used for the literature search were accessed through the Walden Library. Some of these databases are

CINAHL Plus, EBSCO, Google Scholar, MEDLINE, ProQuest, PubMed, SAGE, Science Direct, and multidisciplinary organizational-based databases such as the UNICEF and WHO. The main key words and *MeSH terms* used were *infant mortality, infant mortality in Africa, infant mortality in Nigeria, skilled birth attendant, skilled birth attendant presence,* and *skilled birth attendance presence in health facilities in Nigeria*. The articles used in the literature review were selected based on their relevance to the current research inquiry content. Many qualitative articles were excluded from the literature review because the current study method is quantitative. All the literature were peer-reviewed articles. The articles were all electronic files. All the articles reviewed were written in English language.

Theoretical Foundation

Mosley and Chen (1984) developed the theory that explains the determinants of child survival or mortality in LMICs. The Mosley and Chen model provided insights on how to use evidence-based medical and social science perspectives to inform policies and programs to influence outcome survival among children under 5 years old in developing countries. The basis of the theoretical concept is applied to understand the synergistic influence of both biological and social determinants on low child survival rate and high mortality rate in developing countries (Mosley & Chen, 1984). The two operational constructs described by Mosley and Chen are social science and medical science approaches. The social science and medical approaches include extrinsic factors such as social and environmental conditions that influence the life course perspectives (Mosley & Chen, 1984).

As such, improvement of the social, economic, environmental conditions, preventive, and curative medical modalities are combination of approaches that influence maternal and newborn health outcomes. For example, access to maternal reproductive health and newborn care, ANC or skilled-childbirth attendant care and other logistics such as transportation and health system infrastructure promotes care-seeking behavior for child survival in developing countries (Ndour et al., 2013). Accessibility and availability of well-built or enabling environment that supports easy access to transportation, health infrastructure including health facilities, and clean locale to sustain improved quality of life could substantially reduce infant mortality and increase the rate of survival or life expectancy (Hoope-Bender et al., 2014; WHO, 2015).

Filby, McConville, and Portela (2016) argued that the protective effect of the enabling environment in reducing infant or child deaths should include the incorporation of SBA quality-care during labor or delivery to better promote prevention, reduction, and control of high neonatal or child mortality in most developing countries. Also, introduction of culturally competent SBAs' activities could reduce sociocultural barriers such as insufficient training, low income, and gender inequality, which in turn, could promote better maternal health outcomes and quality care services to improve child survival in LMICs (Filby et al., 2016). The effects of maternal socioeconomic status (SES) (education, income, and occupation characteristics), which directly or indirectly influences pregnancy or birth outcomes has been documented extensively in many studies (Gueri, Gurney, & Jutsum, 1980). The observed relationship between maternal SES and infant or child survival or mortality constructs demonstrate the importance to understand the proximate or intermediate or distant determinant factors described in the Mosley and Chen (1984) theoretical framework. The Mosley and Chen proximate construct provides information about the influence of SES among household units, and effects that could lead to a negative or positive childbirth outcome.

The Mosley and Chen (1984) theoretical framework could also be used to explore and explain infant weight determinants as it relates to health outcomes and survival or mortality rate in developing countries. Regarding the weight determinants, Mosley and Chen operationalized the infant-weight construct as a single measure for morbidity and mortality risk. Low birth weight or SGA (infant with weight below 2.5 kg or 2500 grams) aligns with other published operational definitions of low infant birth weight (Dahlui et al., 2016; Lawn et al., 2014; Mosley & Chen, 1984). Infant LBW or underweight, is known to be associated with maternal malnutrition health status (poor or unhealthy nutrition) during pregnancy. Perhaps, LBW is also linked to infection disease or congenital condition among newborns or children (Lawn et al., 2014; Mosley & Chen, 1984). An infection could occur either during pregnancy or after birth and depending on the type of infection and its severity, the infant growth and developmental processes could be adversely affected (Lawn et al., 2014; Mosley & Chen, 1984). For instance, biological and social mechanisms through proximate factors such as contaminated food, water, environment, air, and other types of infections during pregnancy could deter intrauterine growth, and perhaps, lead to LBW cases (Mosley & Chen, 1984).

Mosley and Chen (1984) described infant weight as a construct of morbidity and mortality risk, which interestingly supported Gomez (1956) findings on this issue.

However, Gueri et al. (1980) and Onis (2000) described differential perspectives on the weight measurement construct. Gueri et al. (1980) and Onis (2000) proposed weight-for-height measure as a preferred risk factor measurement for infant deaths. They also suggested that weight-for-age metric should be applied for screening infant malnutritional state (Gueri et al., 1980; Onis, 2000). Furthermore, Onis (2000) suggested that weight-for-height distinguishes between an acute and chronic malnutritional state as well. Based on treatment modalities, acute malnutrition is treated differently compared to chronic malnutrition (Gueri et al., 1980; Mosley & Chin, 1984; Onis, 2000). Cessation of infant growth (stunting or low height) is linked to malnutrition and maternal characteristics (parity, size, age, and poor diet during pregnancy), premature birth, and intrauterine abnormality (Gueri et al., 1980; Mosley & Chen**,** 1984; Onis, 2000). Whether the risk determinants of a health condition or status were measured using the weight-for-age or weight-for-height, the common and proximate variable for both metric indicators is malnutrition (Gueri et al., 1980; Mosley & Chen, 1984; Onis, 2000). As described above, investigators have demonstrated the applicability and use of the theoretical framework to address child-related health outcomes. Therefore, the use of Mosley and Chen theoretical constructs to explain the links between the key variables in this current study was appropriate.

Malnutrition is one of the predominant health risk determinants in developing countries, especially in rural settings more than in the urban areas (Mitao et al., 2016). According to Mitao et al. (2016), the prevalence of LBW in Tanzania (SSA region) is 16%. To date, the Mosley and Chen’s proposed theoretical weight-for-age concept as a measure or indicator for infant mortality, providing the foundation for standardization of child nutritional reference list especially for nutritional guide to the health status of an infant at birth (Onis, 2000). The SES indirect operation through malnutrition proximate determinants directly influence death risk in neonates in developing countries as well (Bhutta et al., 2013). Therefore, examining the integration of social and biological interventions mediating infant mortality is a critical approach in reducing the under-five mortality for children living in LMICs (Mosley & Chen, 1984).

Mosley and Chen (1984) defined proximate or intermediate determinants as the pathway through which the high infants or children mortality risk could occur. However, one of the premises of the model is that most children under the age of 5 years old are expected to survive within optimal environment, except when the proximate factors for child survival are suboptimal (Mosley & Chen, 1984). Integration of the biosocial and social interactions operate through the proximate determinants synergistically, which promote risks whose outcome could lead to death of an infant or child under the age of 5years old (Mosley & Chen, 1984). Proximate factors are categorized in five main concepts: (a) maternal characteristics – e.g., childbirth interval, parity, and age; (b) environmental contaminants – air, food, water, soil, inanimate object, vectors, and pests; (c) nutrient deficit – protein, calories, micronutrients, and vitamins or minerals; (d) injury–whether accidental and/or intentional; and (e) personal wellness or illness control through care-seeking behavior of mothers during pregnancy, childbirth, and post-partum (Mosley & Chen, 1984).

The application of the Mosley and Chen (1984) framework for this current study in the context of pregnancy care through SBA or before or during or after childbirth means that SES status must be considered in programs and interventions when providing health care. Such approach could provide opportunities to properly address the biological and other determinant approaches to improve reproductive and newborn care, and health status, and to substantially reduce neonatal mortality. For example, the maternal care-seeking behavior access, improvement of micro- or macroelements, and pregnancy nutrient intake (e. g. of proximate factors) should receive priority to alter infant morbidity and mortality (Mosley & Chen, 1984). Poor or unhealthy maternal food intake (malnutrition), limited access to ANC or SBA, and limited education and infrastructure, influences infant stunting growth (short height-for-age) during developmental processes or could lead to other complicated health outcomes or even infant or child death (Adedini et al., 2015; Mosley & Chen, 1984). Several researchers applied the Mosley & Chen theoretical framework to investigate and explain many neonates or infant or child outcomes.

One of the social components associated with mortality in children younger than 5 years old is low SES (Gueri et al., 1980; Murray, Gakidou, & Frenk, 1999; Onis, 2000). As demonstrated in many studies, low SES adversely influence pregnancy and birth outcomes (Gueri et al., 1980; Murray et al., 1999; Onis, 2000). The relevance of the Mosley and Chen theoretical framework is that I used it to explain the observations or identified factors associated with IM risk in Nigeria. Furthermore, by explaining the identified facilitators and barriers associated with survival rate or death rate of infants, I was able to inform targeted policy and interventions expected to advance lifestyle behavior changes among reproductive women and community-driven positive social change. According to Koffi et al. (2017), the prevalence of neonatal and childhood mortality is high in SSA countries. Therefore, addressing IM in Nigeria through this research inquiry is necessary and warranted. As such, understanding modifiable risk factors in Nigeria related to the sociodemographic, social, economic, cultural determinants of IM is important.

Literature Review Related to Key Variables and Concepts

Sociodemographic, Social, Economic, and Cultural Factors

In Nigeria, sociodemographic characteristics play important role in maternal care-seeking behavior during pregnancy, childbirth, and after delivery. The maternal population in the northern areas has higher home-based childbirth delivery than those in the southern regions (Akinyemi et al., 2015; Shiferaw et al., 2013; Singh et al., 2014). The overall use of health facility by pregnant women for child delivery, in both the North and South areas, is low (Koffi et al., 2017). In the North, many of the mothers have lower level of education (Shiferaw et al., 2013). Therefore, more women have children at younger age than those who spend years going to school to attain higher education (Koffi et al, 2017; NPC & ICF, 2014). Overall, low uptake of maternal care, health literacy, and other pregnancy related measures among less educated women in the northern part of Nigeria substantially contributed to the high prevalence of neonate deaths (Koffi et al, 2017; NPC & ICF, 2013). It appears that health literacy and education are important factors that promotes the adaptation of health-seeking behavior and adherence to healthy lifestyle change behavior to improve quality of life as well as medical practices. .

Inadequate maternal education and low literacy on pregnancy, delivery, and childbirth care increases the risk of IM and lowers the odds of infants' survival in health-care setting (Koffi et al, 2017). Understanding the level of the difference in IM outcomes compared to the mothers' literacy levels and SBA presence or absence during child delivery could be necessary to influence health policy on maternal care in Nigeria**.** In Nigeria where home-based delivery is high and common among local women, according to Koffi et al. (2017), it is important to conduct a community-based study to understand the risk factors associated to IM to improved education and health awareness among vulnerable women including health-based care for mothers who have difficult labor and delivery that started at home.

While the risk of nonthreatening complications during pregnancy before childbirth delivery with or without SBA in health facility and IM has not been explored in Nigeria, Liambila and Kuria (2014) found that nonlife-threatening pregnancy (i.e., nonobstetric) complications contributed to lower IM with home childbirth in Kenya. In other words, obstetric complications during labor and delivery that started at home accounted for higher neonatal mortality (Liambila et al., 2014). Also, mothers who had unsuccessfully labor and delivery at home were transferred to health facility due to obstetric complication in Western Kenya (Liambila et al., 2014). In a sharp contrast, Stanley et al. (2016) suggested that infant mortality rate in SSA regions is lower among women that had a child delivery at home (home-delivery) compared to those who had health facility delivery. However, the claim needed additional evidence-based support regarding differences in infant death risks factors between home-delivery and health facility delivery. Perhaps, in this current study, additional evidence-based findings on factors associated with health facility driven IM could be identified.

Qualified midwives, doctors, and nurses in contrast to nonformal SBAs (traditional birth attendants, mother-in-law, friends, and relative) apply clinical or medical procedures in childbirth delivery and detecting early signs and symptoms of birth complications, which could prevent neonate deaths (Filby et al., 2016). Therefore, to meaningfully address the complication issues (whether nonthreatening or obstetric or emergency complications) inherent with pregnancy delivery at any settings, the need for SBA presence at the time of labor and delivery at home-delivery should be rigorously explored. In this current study, the assessment of the level of IM as a function of SBA (e.g. midwife or nurse) presence or absence in the home delivery in comparison to health facility delivery's SBA present during childbirth could be useful in evaluating infant death differences, if any.

With the application of SBA approach for childbirth delivery at home, some of the barriers regarding maternal healthcare access such as uptake of ANC visits could reduce and prevent infant deaths in developing countries (Joseph, Mohnsam da Silva, Wehrmeister, Barros, & Victora, 2016). According to Murray et al. (1999), SES inequalities among marginalized pregnant women, especially reproductive women within low wealth quintile, limited education, and those living in the rural areas, has higher rate of IM. As such, incorporating SBAs in home-childbirth processes could address some of the SES related adverse infant health outcomes.

Infrastructural Barrier

Many researchers applied Mosley and Chen theoretical framework using the integration of social and biological process to explore IM in low income countries (Akinyemi et al., 2015; Gueri et al., 1980; Kayode et al., 2014; Murray et al., 1999; Onis, 2000). In health facility delivery, over 50% coverage in maternal healthcare access was equivalent to 50% reduction in IM within low income countries (Tura et al, 2013). However, regional variation exists in infant mortality due to inequalities in wealth, SBA characteristics, and cultural norms (Adedini et al., 2015; Berhan & Berhan, 2014; Moyer et al., 2013). Understanding the biosocial mechanism that influence IM based on country-specific sociocultural, economical, and environmental dynamics is useful in maximizing and tailoring the effect of targeted community-based programs to improve infant survival and subsequently reduce under five mortality in developing countries (Gueri et al., 1980; Lawn et al., 2014; Mosley & Chen, 1984; Murray et al., 1999).

On the other hand, it’s imperative to examine barrier to SBA provision of quality of labor and delivery care (intrapartum care) of childbirth to determine the effect on neonatal death in health-based delivery in LMIC settings. Also, performance of childbirth care quality is multidimensional levels. In other words, uncertainty exits and may indicate that the intrapartum care-quality of SBA for routine processes and practices in maternal care and child delivery could be sub-optimal to influence infant outcomes (Marchant et al., 2015). Donabedian framework addressed quality-care indicators during labor or delivery and classified it into three components, processes, structure, and outcomes (Tripathi, 2015). According to Tripathi (2015), women who perceived low quality of care even during difficult labor and delivery that started at home may bypass a nearby health facility for another one considered to have better SBA provision of high quality maternal and neonatal care. This is an important supply-barrier influencing maternal death and may consequently lead to newborn mortality (Tripathi, 2015).

Filby et al. (2016) suggested another supply side challenge contributing to IM in developing countries, which included fragmented healthcare system, infrastructures, contaminated drinking water, food contamination, and availability of and access to qualified SBAs. It appears that these factors co-exist and exert synergistic effect in influencing neonatal death outcomes in poor-resource countries. Low retention rate of motivated SBAs due to low wage, inadequate training, and high overloaded work capacity is another supply-demand imbalance affecting quality maternal and newborn care health status (Rwashana, Nakubulwa, Nakakeeto-Kijjambu, & Adam, 2014).

Another study aligned with Rwashana, Nakubulwa, Nakakeeto-Kijjambu, and Adam (2014) findings in support of the multifactorial SBA challenges in providing high quality maternal and newborn care is based on inequalities practices towards women (Filby et a., 2016). As such, sociocultural norm, lack of empowerment, and rumination differential are associated with hierarchy between the man-associated (gender associated) type career (doctors) and SBA female-like profession characterized by feminism in low income countries. It is common to think that SBAs in LMICs have the necessary qualification of SBA (midwives/doctors/nurses) as defined by WHO, rather, some SBAs qualified through in-training practice by working alongside formally trained midwives conducting childbirth deliveries (Joseph, 2016; Singh et al., 2014). Subsequently, due to lack of proper training of SBAs, the quality of care may vary and could affect the maternal and child health outcomes during delivery.

Health Facility Delivery

A review of systematic meta-analysis article about health facility childbirth across many SSA regions, which included data from January 1995 to December 2011 were evaluated (Moyer & Mustafa, 2013). The evaluation involved a cross-sectional design of household survey to examine determinants risk factors of health facility delivery (Moyer & Mustafa, 2013). In the study, the number of articles that met the inclusion criteria were 65 out of the 1,168 identified on the topic (Moyer & Mustafa, 2013). The identified barriers associated with health-based facility delivery within SSA region were antenatal care, maternal characteristics, perceived quality of care, individual characteristics, and socioeconomic factors. Maternal education and place of residency were also identified as determinants of IM (Moyer & Mustafa, 2013; Sartorius & Sartorius, 2014).

Another determinant jeopardizing the processes of effective and efficient maternal health facility delivery in developing countries included interpersonal communication barriers and lack of culture-sensitive communication approach in tailoring health messages (Shiferaw et al., 2013). Additionally, the maternal out-of-pocket cost, nearness to a health-delivery center, and fewer number of ANC visits during pregnancy were key contributors to failure to properly scale the uptake of skilled-childbirth in LMICs (Shiferaw et al., 2013). In the study, Shiferaw et al. (2013) used mixed method approach, a combination of the quantitative and qualitative strategy for the community-based survey and focused group interview. As the title of the article “Why do women prefer home births in Ethiopia?” highlighted, it seems that more public health work using culture-tailored messages is needed to persuade pregnant women to improve child birth outcomes in a safe health facility environment where qualified SBA supervision is available and accessible (Shiferaw et al., 2013). The implication for low proportion of health facility childbirth was unaddressed missed opportunities for proper postpartum and newborn care provision by qualified nurse, doctor, or midwife (Shiferaw et al., 2013). Also, to safeguard against the danger of omitting preventable health complications that might occur in infant and mother post childbirth, the need for health-institutional delivery post-care should be encouraged (Shiferaw et al., 2013). Besides unfavorable experience of women for maternal health services such as lack of available transportation, maltreatment by the SBA, and disrespect, the choice of place of delivery (home-delivery assisted by the traditional attendant (TBA) compared to health facility childbirth assisted by formal and trained midwife, nurse, or doctor) was identified as a risk factor (Shiferaw et al., 2013).

TBA and SBA

In Kazungula, Zambia, the trained TBAs (tTBA) mainly women who performs child delivery at home in rural areas, were banned by the government from such childbirth health care practices (Cheelo, Nzala, & Zulu, 2016). The goal of Cheelo, Nzala, and Zulu (2016) was to evaluate the effect (positive or negative) of banning the use of tTBA for infant delivery at home, and to examine whether the shift to health facility delivery would reduce IMR. Homogenous sample size of 22 tTBA and women district leaders (those entrusted with the women reproductive issues and other affairs of the community) were involved in the study (Cheelo et al., 2016). Based on the ban, the workload capacity of SBA in health facility delivery systems dramatically increased (Cheelo et al., 2016). As a result of the increase in the maternal and infant care in health facility in Kazungulu, Zambia, SBAs spend fewer quality time in attending to pregnant women needs and delivering high quality health care services. Overall, there was no significant difference for SBA protective-intervention in reducing neonatal death in health facility delivery even with the increase in the SBA use among these women (Cheelo et al., 2016).

According to Cheelo et al. (2016), the effects of the ban produced mixed outcomes. The positive effect of the tTBA ban increased health promotion awareness and recognition of obstetric complications during labor and delivery that started at home as a health risk (Cheelo et al., 2016). The negative aspect is that some tTBA still performed childbirth despite the ban of such practices (Cheelo et al., 2016). Also, the delay in transportation or lack thereof to move women in labor from their home or other location to a nearby hospital or clinic for child care and delivery substantially increased the complication risks and cases of maternal and/or IM in the area (Cheelo et al., 2016). Also, based on the compulsory cessation of home-delivery by the tTBAs, health facility delivery increased, but the idea was not supported by many women (Cheelo et al., 2016). In part, one reason for the low rate adoption of or adherence to the ban, was due to the sociocultural norms ingrained in the home-delivery, which were almost absent in the health-based facility delivery systems (Cheelo et al., 2016). Cheelo et al. (2016) findings, which show no statistical difference in neonatal mortality reduction due to increased use of the health facility delivery, in Zambia, supported the Singh et al. (2014) observation on this issue.

Singh et al. (2014) found no association between facility-delivery that employs the use of SBA at labor/delivery and decline in infant mortality in SSA. Singh et al. (2014) used a pooled demographic health survey methodology to collect data from Latin American/Caribbean, African, and Asian countries. The inclusion of multiple countries with different social, political, environmental, and economical backgrounds provided sufficiently representative sample size pool and variability when comparing the effects or impacts of SBA application at child delivery in different demographic and population settings (Singh et al., 2014). The national representative sample size used was 53,474 women, 15-49 years old (Singh et al, 2014). Women who had a childbirth within five years prior to the study (Singh et al, 2014). The heterogeneous sample size comprised of nine countries from the LMICs. The findings of the study showed high infant mortality with skilled-childbirth in Africa compared to Asia and Latin America (Singh et al., 2014).

SSA regions seems to have limited-resources that facilitates social and logistic challenges (inadequate supplies, technology, immunization, equipment, infrastructure, and cadres of SBA-workforce) (Agyepong et. al., 2017). As a result, maximization of maternal and child healthcare services at labor and delivery in health facilities are substantially compromised (Agyepong et al., 2017). Agyepong et al. (2017) suggested that SBA interventions alone cannot significantly reduce infant mortality without quality healthcare systems and infrastructures in Africa or any similar settings. A case study review of various countries in west Africa, Nigeria among the studied countries, highlighted the adverse health impacts of weak healthcare systems and infrastructures that hinders and poses substantial challenges in attaining the stipulated MDG-4 set to reduce mortality among children younger than5 years old (Agyepong et al., 2017). In practical sense, the MDG-4 goal is anticipated to reduce neonatal mortality prevalence to 12 deaths per 1000 live births in priority regions by 2030 and to strength the supply-side factors such as healthcare systems (Agyepong et al., 2017). The research method used in this study was a mixed approach. It added values to understanding the barriers and facilitators of maternal and child care services through quantitative and qualitative perspectives to address how to reduce newborn deaths in west African countries such as Nigeria, Burkina Faso, Ghana, Benin, Mali, and Senegal (Agyepong et al., 2017).

Global Infant Mortality Rate Progression

While the global under-5 mortality rate is slowly declining, between 1996-2015, China demonstrated fast and progressive decline in the mortality annual average rate of 8.2% among the children under five years old (He et al., 2017). For instance, the under-5 mortality declined from 50.8 death per 1000 live births to 10.7 deaths per 1000 live birth between 1996 to 2015 (He et al., 2017). As a result, China already successfully achieved the MDG-4 goal in 2015 much earlier before the 2030 timeline (He et al., 2017). An evidence that the MDG-4 goal is achievable. However, regional disparities in IM versus childhood mortality spanned across the country (He et al., 2017). Among childhood death reported, the western regions had higher mortality rate than central and eastern regions by 10%, over many decades (He et al., 2017). Cases of injury, pneumonia, and rural differential in child mortality should be addressed vigorously in the western regions (He et al., 2017). It appears that the observed differences in regional variation are determinants underlying changes in health outcomes within specific areas.

There is poor or no repository systems in developing countries to capture home-delivery. It also appears that in developing countries, there is overwhelming concerns by health practitioners that the practices of home-based delivery or childbirth in addition to the underequipped health-facilities and fragmented healthcare systems increases the risk of birth complications. Compared to poor settings, infant birth, and death records of the planned home-delivery outcomes is encouraged in highly technologized countries such as the United States (US), Europe, and Canada (Cheyney et al., 2014). In such countries, midwife-assisted planned home delivery has linkages to the health systems and community health services (Cheyney et al., 2014). The midwife or SBA coordinated care and records of ANC home visits and the registration of clients in the system for home-care are well documented and regulated as well (Cheyney et al., 2014). Likewise, records of the labor and delivery outcomes including data on cases transferred to health facility for BEmOC or CEmOC due to obstetric complication during delivery are well documented and captured (Cheyney et al., 2014).

According to Cheyney et al. (2014), successful pregnancy outcomes where the cases had effective transfer to a higher level of care (health facility) to mitigate life-threatening or obstetric complications were described. The intrapartum cases were properly and adequately managed through the midwife early on by applying quick medical interventions during the home-delivery, a process which may not be readily available in low income countries where poor logistical structure, underequipped physical infrastructure, limited SBAs, delayed-seeking preventive or curative care, fragmented healthcare systems, and high rate of social determinants facilitating infant mortality and hindering child survival are prevalent (Agyepong et al., 2017; Akinyemi et al., 2013; Cheyney et al., 2014).

Based on many barriers and concerns associated with safe delivery, it is not a surprise that infant mortality relating to home-based delivery is higher compared to health facility childbirth (Chinkhumba et al., 2014). Even when home-childbirth is linked to high proportion of IM, less obstetric complications were observed (Cheng et al., 2013). In other words, IMR is likely higher with life-threatening complications than non-obstetric complications (Cheng et al., 2013). Nonetheless, regional variability plays a key role to maternal and infant mortality in SSA (Chinkhumba, 2014; Moyer & Mustafa, 2013; Moyer et al., 2013).

In the US, the SBA assisted-home-childbirth accounted approximately 16, 924 SBA-lead home delivery medical records. Home-based delivery in the US increased by 41% between 2004 through 2010 compared to fewer numbers of home-based delivery recorded from 1990 to 2004 (Cheyney et al., 2014). Based on this review, there is a positive trend and successful pregnancy outcome in the planned home-childbirth approaches in the US (Cheyney et al., 2014).

Enabling environment and other essential facilitating determinants are synergic in contributing pregnancy outcomes (Hoope-Bender et al., 2014). Adequate medical supplies at home-delivery including SBA presence for the provision of quality care during pregnancy and labor or delivery is warranted (Hoope-Bender et al., 2014; Tura, 2013). Also, post-natal care and access to medical transportation from home-based delivery to health facility for appropriate medical intervention in cases of obstetric complications should be readily available (Hoope-Bender et al., 2014; Tura, 2013). Functional communication and resource linkages between SBA at home-delivery and health-facilities or health care systems could improve the survival rate of infants during and after birth (Tura, 2013). The fundamental difference between planned home-delivery in advanced countries is the consistent use of SBA-driven childbirth care services compared to home-based childbirth in LMICs, which in many cases lacks SBA or perhaps employs TBA for child delivery (Hoope-Bender et al., 2014; Tura, 2013).

In one study, secondary data was used in a Web-based setting to evaluate pregnancy outcomes, ANC, delivery, post-delivery care, maternal and newborn. According to Cheyney et al. (2014) there is a substantial reduction in IM at home-planned childbirth in developed countries compared to home delivery in LDCs (Cheyney et al., 2014). However, the findings should not be generalized outside of the target population used in the study. Unlike secondary data analysis, qualitative approach provides information about the subjective nature of lived-experiences (Rahman, 2016). With a qualitative study, participants had the opportunity to describe their real-life experiences.

In a qualitative study conducted to explore the facilitators and barriers to facility-based delivery in low and middle-income countries explored how individuals perceive health facilities as a choice for child delivery (Bohren et al., 2014). It appears that perception whether positive or negative could promote actions that may advance adherence to healthy behavior or inaction and lack of adherence to a behavior or health practice, respectively. The study provided guidance to the synthesis of determinants perceived as barriers and facilitators that influence individual choice about selecting a place or settings for delivery of an infant [home-based versus health facility] (Bohren et al., 2014). A total of 34 articles, were included for the meta-analysis (Bohren et al., 2014). The articles selected were generated from multiple countries including Asia, Middle-East, South America, and Africa (Bohren et al., 2014). The authors indicated that there is a gap in communication between the healthcare-system approaches and perception in the community regarding maternal health behavior changes (Bohren et al., 2014). For example, in SSA, 48% of pregnant mothers engaged in skilled-childbirth care (Bohren et al., 2014). The findings are consistent with and supports the high home-delivery demand observed over health facility childbirth in low income or developing countries in the SSA regions (Habte & Demissie, 2015; Pasha et al., 2013, Stanley et al., 2016).

Health Literacy and Cultural Competency

Limited literacy or knowledge deficit on maternal and newborn health contributes to the low proportion of childbirth delivery in the health facilities. Among women who participated in the study conducted by Bohren et al. (2014), there was shared opinion by these subjects that the health facility care systems for childbirth were mechanized, foreign, and socioculturally insult or insensitivity on ways in which the delivery processes and practices where set up (Bohren et al., 2014). Negative interpersonal relationship between pregnant women and SBAs during labor and delivery was identified as another barrier (Bohren et al., 2014). Whereas for the home-based child delivery, pregnant women or mothers or respondents suggested that they experienced positive and close relationship with the non-SBA (TBA) before and after the childbirth (Bohren et al., 2014). Suggesting that at minimum, such relationship supports cultural sensitivity, belief systems, positive attitude, trust, and confident in the practice of home-childbirth over health facility delivery approaches (Bohren et al.).

Delivery site in terms of home-based or health facility setting is one of the main determinants of maternal and child mortality in developing countries (Chinkhumba et al., 2014). However, obstetric complications such as premature complications can be prevented in health-based facility delivery where BEmOC/CEmOC is available (Chinkhumba et al., 2014). The CEmOC or BEmOC application in health-care promote utilization of obstetric equipment and supplies by emergency specialists in providing needed procedures and services to address any life-threatening pregnancy complications (Pasha et al., 2013; Sharma et al., 2015). Also, Stanley et al. (2016) reiterated that health facility related morbidity and mortality of maternal and newborns in SSA is of great concern.

Using a cross-sectional design and health survey data, Stanley et al. (2016) demonstrated that high infant death in health facility delivery in the SSA regions persist. In the study, strong association was found between health facility childbirth and infant deaths in Sierra Leone and Ghana (Stanley et al., 2016). There was a statistical significance value (*p=0.01*) towards a positive association between IM and health facility delivery (Stanley et al., 2016). Interestingly, in Ghana and Sierra, fewer IM was associated with delivery conducted by the non-SBA than health facility childbirth assisted by the formal-trained SBA during delivery (Stanley et al., 2016). In other words, there is a higher IM for child delivery with SBA delivery compared to home-based birthing performed by TBA, friend, or mother-in-law.

Also, in Kenya, higher IM is correlated with health facility delivery with the assistance of SBA (trained and qualified midwife, doctor, and/nurse) while lower IM was observed for home-delivery with non-formal SBA performing childbirth (Koffi et al., 2015; Stanley et al., 2016).

Integration of SBA in quality care during labor and delivery could prevent 289,000 maternal deaths, 2.8 million neonatal deaths, and 2.6 million stillbirths every year (Sharma et al., 2015). The mixed method approach was used to explore the quality care during labor and birth delivery (Sharma et al., 2015). They examined the barriers associated with SBA, BEmOC, and CEmOC implementations in improving neonatal and maternal care, especially in Asian and African countries (Sharma et al., 2015). They suggested that by strengthening the healthcare systems through improvement of infrastructure, SBA-training, and workforce salary, maternal and child mortality risks could be substantially reduced (Sharma et al., 2015).

Benefits and Costs

It was suggested that there is a positive relationship between health facility delivery and infant death decline (Altman et al., 2017). Benefits gained in child delivering in health facility childbirth such as safety and quality care provided by SBAs, perhaps, protected mothers and newborns from unpredicted obstetric-complications (e.g., severe bleeding, obstructed and long labor over a 12-hour time-period, and eclampsia-pregnancy induced high blood pressure) (Altman et al., 2017). Such health or medical benefits may not be possible or achievable in an unplanned or planned home-based delivery settings (Altman et al., 2017). In other words, infant or child survival is anticipated to be higher when the delivery is within a health facility setting (public and private) with the assistance of SBAs compared to deliveries that are home-based (Altman et al., 2017; Berhan & Berhan, 2014).

The out-of-pocket costs associated with maternal and infant care was a major barrier for access to BEmONC or CEmOC, especially when a life-threatening labor or delivery complications occur (Sharma et al., 2015). The vulnerable population particularly, individuals in the rural areas, the hard-to-reach mothers, women in SES quantile, and women in mortality high areas are at lower SES, have high burden of out-pocket costs (Altman et al., 2017). It aligned with other studies that indicated high infant mortality prevalence among households with low SES (Altman et al.; Gueri et al., 1980; Lawn et al., 2014; Murray et al., 1999; Rwashana et al., 2014). Also, Mosley and Chen (1984) framework provides the constructs to describe and explore policies and interventions via social and biological perspectives to address the SES influences operating through proximate and distant factors to influence infant mortality in developing world.

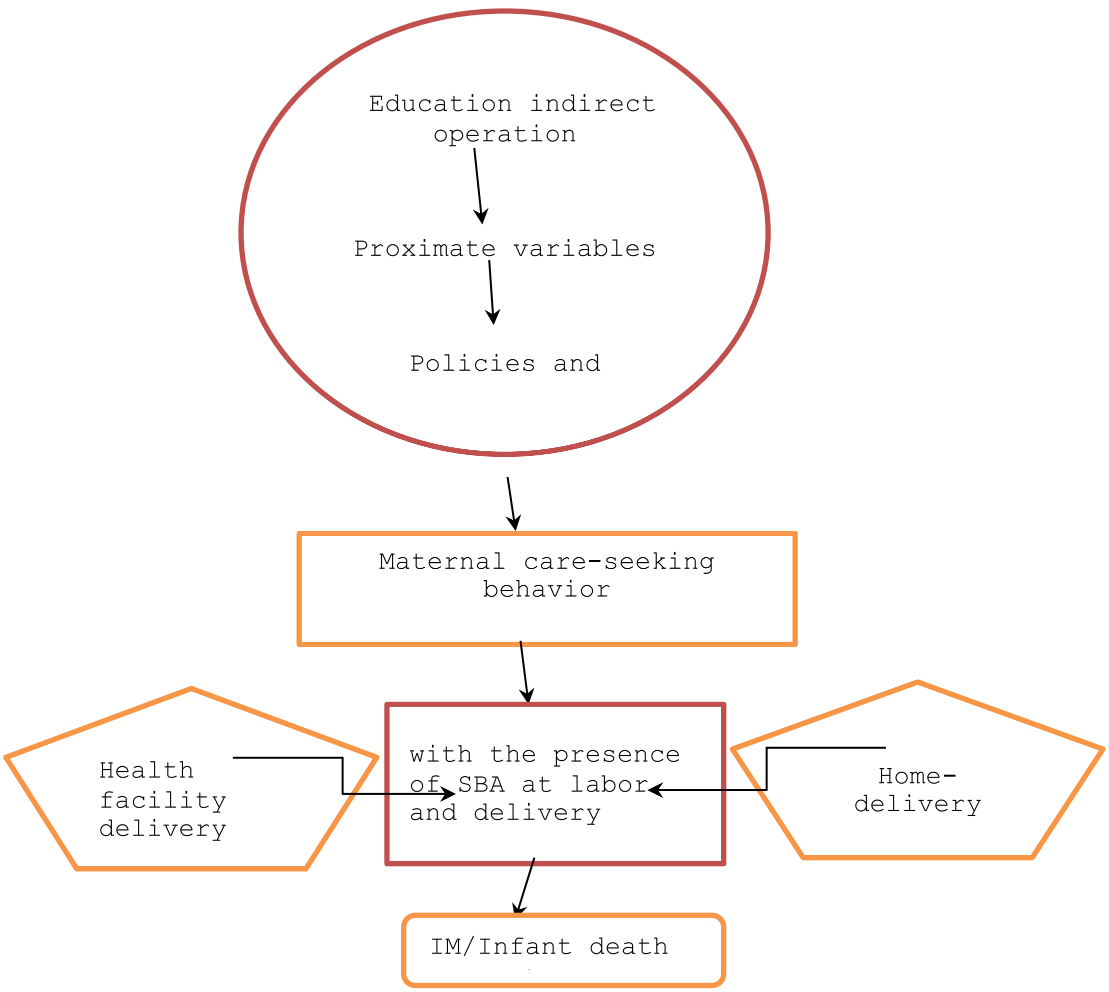

Figure 2. Conceptualizing the socioeconomic status: Pathway to infant survival

Similarly, inadequate maternal health care related to low SES barriers accessing health facility delivery, ANC, and negative impact on maternal characteristics were identified as major determinants to the persistent high infant mortality in Nigeria (Akinyemi et al., 2015). Akinyemi et al. (2015) used mixed method to explore data composed of various demographic and health surveys, vital registry, and population census bureau information in their study. IMR is high in Nigeria despite the amount of program-driven interventions developed to reduce modifiable factors such as short birthing intervals between pregnancies (maternal characteristic), cultural beliefs, low maternal education and immunization, rural-urban differences, contaminated drinking water, and inadequate toilet facility (Akinyemi et al., 2015). A retrospective research design was used to generate the 1990, 2003, 2008, and 2013 NDHS data, which was used to analyze the micro (maternal or individual) and macro (community and societal) environment influencing IM in Nigeria (Akinyemi et al., 2015). Also, neonatal (age range between 0-28 days old) and children younger than five years old have the highest mortality rate as demonstrated in south Asia and Africa countries (Akinyemi et al, 2015; Alkema et al., 2014; Lawn et al., 2014; You et al., 2016). Bayesian b-spline bias-reduction model was used for the data analysis, which was also applied to control the effects of the selected confounders (Akinyemi et al., 2015). Univariate and multiple regression tests were used to analyze the association between the bio-demographic or maternal factors and IM (Akinyemi et al., 2015).

The effects of inequality in terms of SES on NMR was investigated in LMICs (McKinnon, Harper, Kaufman, & Bergevin, 2014). The 2008 demographic and health survey (DHS) was used (McKinnon, 2014). A disproportional increase in infant death rate based on wealth distribution and educational inequality in Cambodia and Ethiopia was observed (McKinnon et al., 2014). Household income inequalities was correlated to neonatal mortality rate across countries such as Mozambique, Senegal, Nigeria, and Rwanda (McKinnon et al., 2014).

Low Birth Weight Factors

Low birth weight is an important contributor to the increase in the infant mortality rate in high burden-areas (Dahlui et al., 2016; Lawn et al., 2014). It is also a precursor for premature birth (Dahlui et al., 2016**)**. Therefore, IM outcome measured by low birth weight (small-gestational-age) is operationally defined as infant weight less than 2,500g or 2.5kg at birth (Dahlui et al., 2016). LBW is a global public health concern, and Nigeria has approximately 5-6 million infants with LBW, annually (Dahlui et al., 2016). The prevalence of LBW in Nigeria is small compared to the global estimate (Dahlui et al., 2016). However, regional variation exists within and across the country (Dahlui et al., 2016).

In Nigeria, infant LBW or small-for-gestational age is higher in Northwestern zone compared to Southern zones (Dahlui et al., 2016). A quantitative method approach using the 2013 national representative data was used in the study (Dahlui et al., 2016). Multiple variables such as the mother's body mass index (BMI), maternal height, parity, physical abuse, birth interval, multiple gestation, paternal educational level, household income, illiteracy, age, and inadequate ANC visits during pregnancy were evaluated as key factors to LBW outcome (Dahlui et al., 2016). Therefore, development of program must be geared toward targeted policy and intervention to reduce the effects of these factors attributable to neonatal mortality (Dahlui et al., 2016). It appears that the evaluation of these variables quantitatively is important to explore the predictors influencing IM in Nigeria. Unfortunately, there are limited quantitative studies on perinatal outcomes (especially infant deaths) in SSA regions, in turn undermines identification of specific determinants, which could be helpful in developing actionable solutions to improve neonatal survival in LMICs (Lawn et al., 2014).

IM Outcomes and Health Coverage

Tura et al. (2013) applied a systematic meta-analysis approach in their study to explore the effect of health facility delivery on IM outcomes. Nineteen studies met the inclusion criteria, out of 2, 216 articles extracted, the studies were conducted in poor-resource settings (Tura et al., 2013). The small number of the articles that met the criteria in comparison to the total number reviewed, supported the idea that a low proportion of research was conducted in developing countries. The paucity of research in LMICs is an issue that should be addressed. However, in Tura et al. (2013) study, health facility delivery assisted by qualified SBA reduceed IM up to 40% when maternal health coverage is 50% or more including presence of enabling amenities such as supplies, drugs, clean sanitary environment, and competent or adequate SBA present at delivery (Tura et al., 2013).

Many studies suggested that maternal health coverage is an essential component in optimizing pregnancy outcomes (Kumar et al, 2014). Infants born to mothers who have maternal health access are likely to deliver in health facility compared to those whose mothers had childbirth elsewhere, such as home-delivery (Adebowale & Udjo, 2016; Tura et al., 2013). It was suggested that pregnant women who have maternal health coverage are likely to delivery at a health facility, and perhaps provide opportunity for newborn care and services to improve survival. Adebowale et al. (2016) explored the association between infant deaths or survival and maternal healthcare coverage use in

Nigeria. In the study, they employed a cross-sectional design and used the Cox-proportional hazard and Brass models to analyze the 2013 NDHS data (Adebowale et al., 2016).

In a similar research study conducted in Gujarat, India, a prospective cohort design was used to explore infant death outcomes in health-care delivery among pregnant women with low socioeconomic status (low education, occupation, income and wealth quintile) (Berhan & Berhan, 2014). In the study, protective-effect of health institutional childbirth was minimal against infant mortality reduction compared to countries with high proportion of skill attendant delivery such as in advanced countries or North African nations that has high proportion of skilled-childbirth (Berhan & Berhan, 2014). Also, the researchers evaluated the relationship between skilled-childbirth and infant, stillborn, and maternal death rate using a pooled DHS data from 1990-2013 (Berhan & Berhan, 2014).

The collected data was analyzed using a linear regression model (Berhan & Berhan, 2014). Findings showed that middle income countries used large proportion of SBA in child delivery (Berhan & Berhan, 2014). There was a positive relationship between fewer IM with skilled-childbirth (Berhan & Berhan, 2014). Even when higher home-based child birth occurs in low-income African countries with low proportion SBA assisted delivery, the research in this area is still limited to ascertain the effects of home-childbirth on maternal andstillborn and neonatal mortality (Berhan & Berhan, 2014).

Another attributable determinant of high IM is access to maternal health coverage for ANC (Kananura et al., 2016). As a result, small proportion of pregnant women have access to health facility (Kananura et al., 2016; Kumar et al., 2014). The implication of low coverage translates to increased use of home-delivery for child delivery (Kananura et al., 2016). Also, multiple supply-factors such as inadequate SBA workforce, training, and low-wage earning promotes the attitude of disrespect and influence quality care provision during delivery (Filby et al., 2016).

Home-Based vs. Health Facility Delivery

Fink et al. (2015) suggested that no effect was observed between facility-based delivery and newborn mortality in 1.47 million data of medical records contained in the DHS data. Rather they found a protective effect on private health-care delivery on IM (Fink et al., 2015). It is possible that inherent recall bias in self-reported interview among individuals pooled in the DHS data source could distort the finding if present (Fink et al., 2015). In the study, pregnancy delivery in health facility delivery (private-sector) was associated with reduced neonatal deaths (Fink et al., 2015). However, in the absence of the private health-institutional delivery (predictor/exposure), the outcome might have been different. The effects of health-institution (private or public) delivery health outcomes in LDCs need further investigation to understand the differences in characteristics between private and public sector health facility childbirth in relation to increased IM in SSA regions (Fink et al., 2015).

Kumar et al. (2014) showed that higher IM is associated with neonatal private-healthcare-delivery. The association is higher among women with low economic strata compared to those in upper wealth quartile (Kumar et al., 2014). It is also possible that differential disparity exists in the quality of care provided by the nurse, midwife, and doctors to disadvantaged women (who often use public health facility) compared to individuals at the upper wealth quintile who use private health facilities for childbirth (Kumar et al., 2014). It appears that the type of care provided and received could affect a big change in health outcomes if such intervention directly addresses and influences the determinants of IM associated with child delivery.

Regarding the variation and social factors attributable to IM in health facility delivery, an ongoing quality-of-care-audit program was developed to assess and monitor IM among participating health-institution in South-Africa (Allanson et al., 2015). The inclusion criteria for the study included health facility with IM data, 5years or more (Allanson et al., 2015). In the study, the modifiable factors contributing to the infant death are recorded (Allanson et al., 2015). The modifiable determinants that were identified among the participating facilities with high mortality prevalence are missed obstetric signs and symptoms, inadequate staffing, lack of identification of fetal distress, and pregnant women under the influence of alcohol during pregnancy (Allanson et al., 2015).

The importance of prenatal audit is critical to inform policy change solutions (Allanson et al., 2015). Audit review identifies where, what, and how to integrate various system levels (Kerber et al., 2015). In the study, a large sample size was used, and qualitative method applied for statistical analysis (Allanson et al., 2015). The purpose of the study was to identify effects of the audit tool on infant death rates in programs within at least 5 years post implementation (Allanson et al., 2015). The other advantage observed in the research was the method used in the data collection by the health facility staff where the death occurred (Allanson et al., 2015).

In 2010-2013, a similar study was conducted in Nagpur (central) and Belgaum (south) in India to assess the patterns and factors contributing to stillbirth, perinatal, and infant outcomes in institutional and home-delivery (Goudar et al., 2015). In the study, a prospective cohort surveillance approach among pregnant women regarding home and health facility deliveries were collected (Goudar et al., 2015). The total sample of pregnant women who delivered a child in Belgaum and Nagpur, India was 64,803 and 39, 081 respectively (Goudar et al., 2015). The heterogeneous large population cohort used was an advantageous in the study observations (Goudar et al., 2015). The investigators concluded that there is an increase in health facility-deliveries with the presence of skilled attendant at childbirth, which produced a decline in stillbirth and perinatal mortality outcomes even while no change in IM reduction was observed (Goudar et al., 2015). Plausible attributable factors in the absence of mortality decline of neonates were linked to low birth weight and asphyxia (Goudar et al., 2015). Also, important risk factor associated with stillbirth and IM is birth asphyxia (lack or inadequate breathing at birth), a major determinant of mortality among infants (Goudar et al., 2015). In cases where asphyxia occur during child birth, SBA could easily and skillfully perform respiratory resuscitative interventions to prevent, minimize, and avert the child's death (Goudar et al., 2015; Fadel et al., 2015).

Maternal and Neonatal/Infant Deaths

According to Islam et al. (2014), presence of SBA during delivery is the most effective and efficient ways to reduce maternal and neonatal deaths. SBA interventions during pregnancy, labor, and delivery could promote substantial reduction in IM associated with preterm birth, infection, and or low-birth weight especially, areas where mortality risk is high (Akinyemi et al., 2015; Singh et al., 2014). SBA presence to provide resuscitation intervention when birth asphyxia occurs is shown to reduce morbidity and mortality incidence (Fadel et al., 2015). Also, post-delivery care such as postpartum checkups provided by midwife or nurse, or doctor or SBA within 24 hours after birth was found to reduce cases of IM (Fadel et al., 2015).

Izugbara (2014) found unaddressed parental education level in household indicator as a barrier in LMICs, which affects mortality of children younger than five years old. In Nigeria, parental education among other social and demographic determinants influence death risks in children (Izugbara, 2014). The sample size used for the study was 36,800 households and women ages 15-49 years old who has at least one child under the age of 5 years old prior to the 2008 NDHS data collection (Izugbara, 2014). Examination of household variables of under-five fatality shows that female education is critical in reducing mortality prevalence among children in Nigeria (Izugbara, 2014).

Preventable maternal risks factors during pregnancy and post child delivery could be effectively examined using maternal death surveillance and response (MDSR) tool (Mathai, Dilip, Jawad, & Yoshida, 2015). MDSR is a global health indicator used to assess the effectiveness and efficiency of services provided during pregnancy in health facility system (Mathai et al., 2015). This approach provides reliable and tailored information about quality health care services during pregnancy, childbirth, and postpartum period (Mathai et al., 2015). MDSR is usefulness and essential tool in areas where maternal and IM is high (Mathai et al., 2015). Most importantly, it could be used to identify modifiable risk factors and its attributable impact to child mortality (Mathai et al., 2015).

Even when it was demonstrated that health facility delivery is increasing in LDC, in 2012, high incidence of adverse health outcomes, which accounted to 7,300 stillbirths, 7,700 infant deaths, and 800 maternal deaths occurred routinely in poor resource areas in spite of the presence of skill-birth rise in 1990 from 56% to 68% in 2012 (WHO, 2016). It is possible that the high prevalence of IM in LDCs could be attributable to multiple factors in developing countries (Alkema et al., 2014; Lawn et al., 2014; Sharma et al., 2015). Therefore, understanding factorial variation by geographic, region, and country-specific determinants of IM could inform targeted policies and programs in reducing disparities and barriers associated with such adverse health outcome (Akinyemi et al., 2013). In another study, a qualitative research method was conducted to understand the sociocultural and socioeconomic themes emerging from the phenomenon of the increasing infant deaths in Tarok, a north-central region of Nigeria (Orisaremi, 2013).

Four communities comprising of 24 focus group and 16 informants were interviewed (Orisaremi, 2013). Despite the inherent limitations of qualitative method approach such as selection bias, recall bias, and non-verification of subjective experiences of an in-depth account of narrative events, a qualitative study could provide several opportunities to help identify contextual and subjective themes linked to IM. Orisaremi (2013) suggested that cultural related practices such as home-based delivery in the absence of SBA plays crucial roles in the decision-making processes of childbirth.

Among community members, home-based delivery practices were perceived as heroic by many women in developing countries (Orisaremi, 2013). Lack of education among rural women and BEmOC or CEmOC were among the identified themes inhibiting local women from participating in health facility delivery (Orisaremi, 2013). In Nigeria, about 62 % of childbirth occur at home (Orisaremi, 2013).

Sankar, Natarajan, Das, Agarwal, Chandrasekaran, and Paul (2016) explored the timing of infant deaths and attributable factors. Of 13,306 literature retrieved for the study, 21 met the inclusion criteria. The study was based on retrospective systematic browsing of various databases (Sankar, et al., 2016). Approximately, 52% of infant mortality occur among children less than 5 years old in resource-deprived countries (Sankar et al., 2016). According to Sankar et al. (2016), asphyxia largely contributed to infant deaths within 24 hours of births. Infant deaths from asphyxia most often occur at early days of life (Sankar et al., 2016). Many researchers showed that obstetric complications such as infection, preterm or premature birth (childbirth less than 37 weeks), anomalies, and intrapartum (labor and delivery) are preventable, yet they are the leading causes of death in neonates in LDCs (Demissie et al., 2015; Ekwochi et al., 2017; Hailu & Berhe, 2014; Lawn et al., 2014; Sankar et al., 2016, UNIGCME, 2015; WHO, 2016). Infant deaths associated with maternal obstetric complications were observed by Sankar et al. (2016) as well.

According to Ekwochi et al. (2017), the complications include birth-asphyxia, preterm birth, and small-gestational-age (low-birth weight) were common cause of infant death. Based on a longitudinal study involving 261 infants who were admitted to newborn-intensive care unit (NICU) in health facility (South-East) Nigeria following the obstetric complication at labor and childbirth that started at home-based delivery had higher mortality risk compared to health facility delivery (Ekwochi et al., 2017). Likewise, transfer of women with life-threatening complications during labor and delivery to underequipped health facility (BEmONC or CEmONC) increases infant death risk (Patel, Prakash, Raynes-Greenow, Pusdekar, & Hibberd, 2017).

Health facility delivery has better neurologic outcomes for the absence of seizure with an Apgar score greater than 7 at 5-minutes interval compared to infants whose mother had home-assisted delivery assisted by TBA (Grünebaum et al., 2013). The difference in neurologic outcomes between home-childbirth and health facility delivery highlighted missed opportunities of SBA’s interventions (Grünebaum et al., 2013). In other words, identification of neonatal asphyxia and other potential neurologic complications require the expertise of an SBA (Grünebaum et al., 2013). Unfortunately, it is difficult to evaluate this phenomenon better because fewer SBA-lead-home-delivery are practiced in developing countries compared to developed countries, which also has strategies for planned home-deliveries (Grünebaum et al., 2013; Cheng, Snowden, King, & Caughey, 2013).

Maternal age is a common confounder to infant deaths. Izugbara (2014) suggested that mothers between 45 to 49 years old had greater proportion of under-five mortality cases compared to women who are younger. The authors used secondary data consisting of 33,385 women ages 15 - 49 years old, who had a living-child within 5 years old (Izugbara, 2014). In another study, it was demonstrated that 62% maternal mortality occurred in SSA regions compared to 56% in 2013 (Gitimu et al., 2015). Renfrew et al. (2014) applied a systematic design to explore infant mortality cases. They showed that provision of good quality of services to maternal and child by a midwife is critical, not only during the crucial time of delivery, but after birth (Renfrew et al., 2014). Additionally, SBAs could address the physiological needs and provide ongoing psychological or emotional support to enhance the well-being of the mother and infant (Renfrew et al., 2014).

Cultural Practices

Even when SBA's provide considerable health care services before, during, and after childbirth within the context of health facility perspective, cultural practices influencing care in most low-middle income countries creates barriers in the uptake and adoption of health facility delivery among local women (Orisaremi, 2013). Such cultural practices include negative perception ingrained on Tarok women in Nigeria to use healthcare delivery only when home-delivery of newborn is in danger and compromised (Orisaremi, 2013). Such perception could pose adverse health risk to the mother and infant. Furthermore, the sociocultural norm regarding relief of labor-pain pose a counter-cultural conflict with the traditional norms for women delivering at first-time (women with first-time pregnancy and delivery) (Orisaremi, 2013). It is possible that the effect of excruciating pain during child delivery could pose as a barrier complying with childbirth delivery coaching activities. Additionally, the forbiddance to express pain at childbirth by the norm could deter woman expression of other subjective feelings and symptoms that could influence child health outcomes for those who had obstructed delivery at home, but delivered in health facility with or without SBA assistance. The study was based on a qualitative approach comprising 24 focus group and 16 informants of males and females, over 15 years of age in Tarok, Nigeria were used to explore the cultural aspects of home-based delivery (Orisaremi, 2013). According to the investigator, various community members from different regions of Nigeria perceived childbirth through the cultural lens of dignity, heroism, and complacence of customary tradition (Orisaremi, 2013).

In SSA culture, a pregnant woman may engage in pregnancy cultural practice to preserve her stoicism (Moyer et al., 2013). In Ghana, a woman in labor could use self-concocted herbal medicine to facilitate labor and delivery (Moyer et al., 2013). The odds of sociocultural behavior practices such as squatting as a cultural practice to deliver a baby may contribute to birth injury or health complications to the newborn and subsequently influence IM in cases where incomplete delivery started at home, but referred to health-based facility to delivery with presence or absence of SBA (Moyer et al., 2013).

Quality of Care and IMR

Leslie et al. (2016) suggested that IMR was association with the quality of care, processes undertaken in delivering routine care to the mothers during intrapartum event in health facility in Malawi. The findings compared the high performing top-25% health facility deliveries in Malawi compared to low-performance and showed an association with reduced IM (Leslie et al., 2016). The estimated significant value in reduced IM was $p = 0.047$ (Leslie et al., 2016). It appears that there is a difference in the IM outcomes, which could indicate variabilities in characteristics of SBA care and services (Leslie et al., 2016). Of 352 related articles reviewed for this assessment, 32 met the eligibility criteria (Leslie et al., 2016). The evidence strengthened the positive position of SBA application and workforce in improving quality of care among pregnant women and infants, but also, performance of quality of care scored was high in the study and was linked to the reduction of risks of IM in health-facilities (Leslie et al., 2016).

Okoli, Morris, Oshin, Pate, Aigbe, and Muhammad (2014) used a pilot program to assess the uptake of the preventive maternal care services with the incentive provision with continuous cash transfer (CCT) of N5,000 Nigerian currency [$30 US currency]. The researchers demonstrated the need for improving the maternal newborn care seeking behavior through the use of preventive measures such as ANC and immunization care services (Okoli et al., 2014). Within 37 primary health facility evaluated, inconclusive findings were reached regarding the behavioral change expectations in the application of SBA, utilization of ANC visits, and immunization at birth (Okoli et al., 2014). However, the frequency of the ANC visits for continuation of care substantially improved (Okoli et al., 2014). Based on the study, maternal or child care awareness care-seeking behavior among mothers in rural areas improved (Okoli et al., 2014).

Similarly, a prospective population-based cohort study in rural Maharashtra, India" was conducted to explore the effects of transfer of women with obstetric complications during labor or delivery from location of incidence to health-facilities for emergency care (Patel, Prakash, Raynes-Greenow, Pusdekar, & Hibberd, 2017). In the study a prospective cohort design was used (Patel et al., 2017). A total of 34,319 (89%)

cohort (pregnant women) from multiple-districts of central India were involved in the study (Patel et al., 2017). Factors associated with infant mortality in the study include bleeding during and after-childbirth, eclampsia, previous obstetric complications, and obstructed delivery issues (Patel et al., 2017). Additionally, the researchers showed that transportation of women with pregnancy or delivery complications to hospital facility with better infrastructure did not improve maternal and neonatal survival rate (Patel et al., 2017). Communication and transportation barriers between inter-hospitals' transfers of cases may in part, explain the unfavorable maternal and infant outcomes (Patel et al., 2017).

A prospective cohort design involving 3,359 women who had a health facility delivery were enrolled in the study and followed between 2008-2010 (Mahande et al., 2013). The purpose of the study was to explore recurrence of preterm risk among the at-risk women (Mahande et al., 2013). Similarly, high prenatal death in North Tanzania requires effective interventions to mitigate household recurrent of perinatal deaths (Mahande et al., 2013). While developing countries have large proportion of infant death rates, north Tanzania estimate is 58 deaths per 1000 live births, Burkina-Faso at 79 deaths in 1000 live births, and Uganda's rate is 41 deaths in 1000 live births (Mahande et al., 2013). In contrast, developed countries have low incidence of IMR (Mahande et al., 2013). For instance, Norway estimate is 4.7 deaths per 1000 live births (Mahande et al., 2013). Consistent with Mahande et al. (2013) findings, the prevalence of IM following obstetric complications was common. Also, stillbirth and infant death was observed in the first week of life, while low birthweight are prevalent among the newborns (Mahande et al., 2013).

In 54 health facilities in South Africa, factors associated with IM was explored using some public health programs (Allanson & Pattinson, 2015). The purpose of the study was to identify the difference in infant death rates among health-facilities participating in the audit program for at least five consecutive years or more from its inception (Allanson & Pattinson, 2015). Factors strongly associated with the increase in infant deaths were inadequate skilled-childbirth, prophylactic treatment during pregnancy, fewer than 4 ANC attendance, and antepartum or intrapartum complications (Allanson & Pattinson, 2015). The data source used was from onsite-mortality dataset from 163 health-facilities, covering up to 3,604,374 and 85,728 IM (Allanson & Pattinson, 2015). The MDSR and perinatal death surveillance responses audit-tool is promissory if implemented and applied appropriately in maternal and infant health care services (Allanson & Pattinson, 2015; Hilber et al., 2016). It is possible that the implementation of the MDSRs may be useful in explaining the regional, geographic, and national variation barriers influencing mortality in priority region such as SSA (Allanson & Pattinson, 2015; Hilber et al., 2016).

Summary and Conclusions

This section of the dissertation covered the literature search strategy, theoretical foundation, and literature review related to the key variables in detail. Based on the body of literature reviewed, IM in developing countries is linked to multifactorial biological and social determinants (Mosley & Chin, 1984). The mortality rate of infant is a global issue, but the proportion of deaths is worse in low income countries of Africa (Lawn et al., 2014; You et al., 2015; WHO, 2015). Mosley and Chin model described here is appropriate for this current research inquiry. The model incorporates interdisciplinary approaches to promote health policy and programs or interventions development to minimize preventable determinants of health.

Several researchers suggested that several determinant factors adversely affecting pregnancy and child delivery are preventable in areas where the IM burden is high (Sankar et al., 2016; Lawn et al., 2014). Although similarity of determinant factors of IM exists, there are regional, geographical, urban or rural differences (Adedini et al., 2015; Wang et al., 2014). On the other hand, Stanley et al (2016) findings emphasized that further study is needed to investigate why delivery in health facility with the presence of SBA is associated with increased risk of IM (p. 7). Thus, the effects of SBA presence or absence, prenatal care or no care during pregnancy, and providers of prenatal care (health facility or traditional provider) on IM cases in health facility was explored in Nigeria in this study. The findings from this study advanced informed knowledge on how to address the risk factors and high IM incidence and prevalence in Nigeria. The information derived could further be used to promote public health efforts on infant survival rate within and around the areas with high IM burden. In chapter 3, the research design and rationale, methodology, and threats to validity was discussed in detail.

Chapter 3: Research Method

Introduction

The increase in IM in health facility delivery in SSA regions has not being adequately studied in public health (Singh, Brodish, & Suchindran, 2014). Thus, I explored the effects of SBA presence or absence, seeking of prenatal care or no prenatal care, and provider of prenatal care (health provider or traditional provider) in health facility on IM outcome in Nigeria. The study results advanceed knowledge on the impacts of the specified risk factors in the increase of the IM phenomenon in health facilities in Nigeria. In this section of the dissertation, the research design and rationale, methodology, and threats to validity were discussed in detail.

Research Design and Rationale

In this current study, secondary data was used for the data analysis. However, a cross-sectional design was used to evaluate whether there is an association between IM and SBA presence or absence, seek of prenatal care or no prenatal care, and provider of prenatal care (health provider or traditional provider) in health facility in Nigeria. The cross-sectional approach is a research design used to collect data when the intent is to explore the prevalence or incidence or the risks of an outcome at a given point in time (Donald, 2007; Kahn et al., 1999; Mann, 2003). A cross-sectional design is cost-effective compared to prospective cohort, experimental, or quasi-experimental design (Donald, 2007).

The idea to use a cross-sectional approach is primarily based on the application of secondary data. A cross-sectional design is appropriate because the secondary data

(VASA data) was collected using a cross-sectional design, thus, it became the default design for the study. Relevant variables of interest for this current study captured in the VASA data included IM, SBA, health facility delivery, home delivery, religion, geographic zone, sex, gender, high blood pressure, diabetes, severe bleeding, education, para-gravida (women with prior pregnancies), primigravida (women at first-time pregnancy), and household characteristics, (NPC & ICF International, 2014).

A longitudinal design or prospective cohort and other forms of research designs could not be used in this current study because the secondary data (VASA data) was generated using a cross-sectional design. The weakness of a cross-sectional design includes recall, selection, misclassification, researcher, and participant biases (Creswell, 2013; Drost, 2011; Kahn et al., 1999). The use of a cross-sectional design limits the inferential assessment to only correlational decisions and not causal effects (Creswell, 2013). Therefore, the use of the VASA data is not intended to detect causal effects of the associations regarding infant mortality, rather, the idea is to explore the correlational relationship between specified variables emphasized in the posed research questions.

Methodology

This current study is a quantitative study. The posed research questions drive the quantitative nature of the study. The nature of the research questions and the level of the measurements for the dependent and independent variables determines the type of statistical approach to use for the analysis of the data. However, the secondary data approach influenced the types and nature of the research questions posed. Since the data to be used in this study has been already collected, the posed research questions did not include any variables outside the parameter of the VASA dataset. Similarly, the research design (cross-sectional approach) is aligned and consistent with the approach used in the VASA data collection. The sets of methodology or approaches such as the statistical approach, secondary data, cross-sectional design, and quantitative method are the elements that embodied the methodology applied in this current study.

Population

Nigeria, a West African country is densely populated with approximately 170 million people (Koffi et al., 2017). The target population discussed in this research is a nationally representative sample for children younger than 5 years old who were represented in the 2014 VASA data or study (NPC & ICF, 2014). The selected VASA sample size of the deceased infants for this current study are less than 1 year old (NPC & ICF, 2014). Nigeria is divided into 36 states, including the Federal Capital Territory Abuja, see Figure 2 (NDHS et al., 2013). According to the 2013 NDHS, Nigeria is categorized in six geographic zones: the North Central (NC), North East (NE), North West (NW), South East (SE), South-South (SS), and South West, see Figure 2 (Koffi et al., 2017).

Each zone is further subdivided into local government areas or enumeration areas (NPC & ICF, 2014). Also, by region, most people in the north practice Muslim religion while majority in the south are Christians (Akinyemi et al., 2015; Fapohunda & Orobaton, 2013). Nigeria is multitribal with groups of people with many dialects and languages (NPC & ICF, 2014). However, there are three populous tribes: the Igbo, Yoruba, and Hausa (NPC & ICF, 2014). Each tribe speaks a native dialect, and due to colonial influence, English is used as the common means of communication across Nigerian living in various areas of the country, especially when the tribes or individual do not have the same native language (NPC & ICF, 2014).

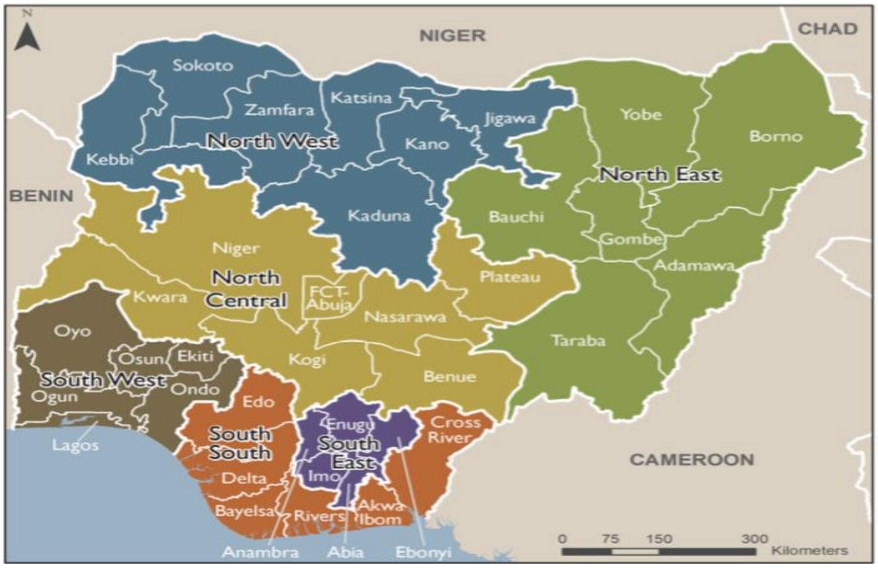

Figure 3. Map of Nigeria: Source: https://dhsprogram.com/pubs/pdf/FR293/FR293.pdf

VASA Data Population

The total population size implicated in the 2014 VASA study or data included 3,254 deceased children (NPC & ICF, 2014). Overall, the 2013 NDHS data employed 38,522 households out of 40,680 sampled households (NPC & ICF, 2014). For the VASA data, the default age range for the deceased neonate is 0-27 days old and 1-59 months old for children that died under the age of 5 years old (Koffi et al., 2017; NPC & ICF, 2014). The VASA data was collected across the 36 states and Federal Capital Territory in Nigeria (NPC & ICF, 2014).

Study Sample Size

Ssecondary data was used for the data analysis to address the posed research questions. The Nigerian 2014 VASA is the source of the secondary dataset (NPC & ICF, 2014). The timeframe for the 2014 VASA collection was from November 1, 2014 to the end of December 2014 (NPC & ICF, 2014). The recruitment process and random selection of the eligible households include mothers who lost an infant before the 2013 NDHS was conducted (NPC & ICF, 2014). Individuals included in the interview are mothers or proxies or caregivers (NPC & ICF, 2014). Women ages 15-49 years old who provided care to the infants were interviewed by VASA personnel (NPC & ICF, 2014). The method of the interview was a face-to face question approach (NPC & ICF, 2014). Among participants who were interviewed, the response rate was 90.5%, which accounted to 2,944 households/respondents out of the 3,254 (NPC & ICF, 2014). The 2014 VASA participants represented reproductive women population that lost at least an infant before the 2013 NDHS was conducted in Nigeria (NPC & ICF, 2014). Of those who were interviewed, the primary respondent in each household was the mother of the deceased infant, representing about 94.6% (NPC & ICF, 2014)

The approach used for the 2014 VASA data collection was a quantitative method (NPC & ICF, 2014). The trained interviewers visited the eligible households and administered VASA survey in their residential places. In other words, VASA collection was a face-to-face interview. The VASA sample selection from each household was randomized (Koffi et al., 2017; NPC & ICF, 2014). The level of measurement for IM is a nominal variable. The occurrence of IM, which was the DV, is a mutually exclusive observation that can only be categorized or measured as either ‘infant death’ or ‘no infant death’. The scale is categorized as binary measurement (dichotomous variables) because it has only two possible outcomes (Marateb, Mansourian, Adibi, & Farina, 2014).

For the first research question, the presence or absence of SBA in health facility delivery is the independent variable (IV) which is the predictor of the health outcome (IM) under investigation. Just as with the IM measurements, the presence or absence of SBA was captured in the 2014 VASA dataset. The presence or absence of SBA in health facility is a nominal variable and mutually exclusive as well. In other words, a childbirth could either have occurred in the health facility with the help and service of the SBA, or no assistance from SBA. For the second research question, the IV, seek of prenatal care or no prenatal care service in health facility is also a nominal variable and mutually exclusive. In other words, the selected woman could only provide information on whether she attended prenatal care during the term of her pregnancy. The IV for the third research question is *provider of prenatal care* which is divided into two categories (health facility provider or traditional provider), which is also a nominal and mutually exclusive variable. The selected women could either provide information on whether they received their prenatal care from health facility provider or traditional provider. Based on the information provided on the level of measurements for the current study variables, the statistical test for the analysis or to address the posed research questions is binary logistic regression, because its assumptions were met based on the specified levels of measurements.

The research procedures and processes applied in the data collection approach for the 2014 VASA data was the same used for the 2013 NDHS population study (NPC & ICF, 2014). Some few parts of the procedure were modified to fit the need of the study (NPC & ICF, 2014). An example of the modification is that a simple randomized selection of eligible households was used in the 2014 VASA sampling while a three-stage-stratified cluster design was used for the 2013 NDHS data collection from nationally representative households that had at least a deceased child (neonatal or child death from the eligible households) in Nigeria (NPC & ICF, 2014).

VASA data estimated a minimum of 600 neonatal deaths based on 50% proportion of the unknown total number between the northern and southern zones, Nigeria (NPC & ICF, 2014). The statistical power used was 80% (Adewemimo et al., 2017; NPC & ICF, 2014). For selecting the appropriate sample size for this current study from the sample population of the 2014 VASA data, the G*Power analysis was performed. The criteria for the sample size estimation included the *z*-test statistical family with emphasis on logistic regression test, since it is the preferred statistical test intended for this data analysis. Also, a predetermined 80% (0.80) statistical power, an alpha value of 5% (0.05), two-tail test, and effect size of 2.5 were used for sample size estimation. The sample size estimation using the G*Power yielded a sample size value of 70 participants, see Figure 4. However, the actual total number of 723 samples (North, 499 and south, 224) was tallied in the 2014 VASA study (NPC & ICF, 2014). For the current study, all the valid 2014 VASA sample counts for the statistical analysis was included.

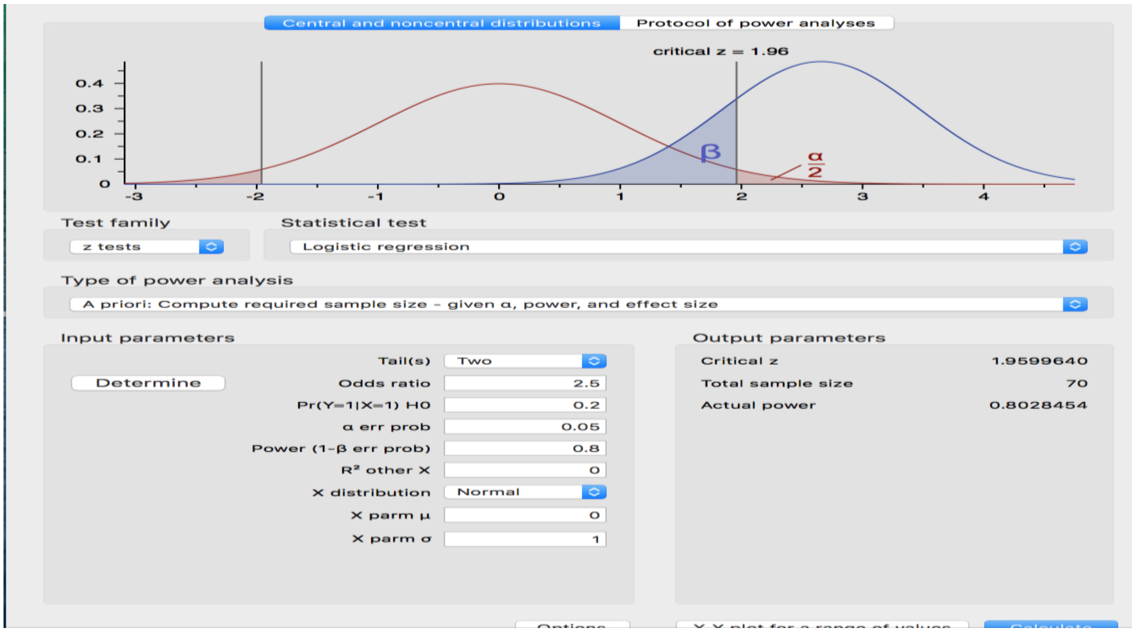

Figure 4. G*Power sample size estimation

Of 3,254 households in the sample size, 2,944 households completed the VASA interview with a response rate of (90.5%) while 310 were missing responses, mainly from the northern zone where the under-five mortality was higher than the southern zone (Koffi et al., 2017; NPC & ICF, 2014). Some challenges for the missing responses were partly due to safety issues regarding the location of some houses, vacant households, eligible person not present, and age of deceased child being above 5 years old (NPC & ICF, 2014). The proportion of the missing data compared to 2,944 households that completed the survey is 10.5%. The missing value was less than 30% and was not included in the analysis. I randomly selected the minimum study samples of 721 participants from the remaining 2,634 samples. Two hundred and forty eight infants were reported with complete information regarding the IV and DV under investigation. The selection criteria were limited to individuals who participated in the 2013 NDHS survey, woman-who completed the questionnaire or survey, pregnancy delivery or events within 3-5 years period preceding the 2013 NDHS (NPC & ICF, 2014). The survey participants are women ages 15-49 years old who lost at least an infant less than 1 year old and individuals living in Nigeria prior to the 2013 NDHS data collection (NPC & ICF, 2014).

The VASA questionnaires used is a combination of two questionnaires: the verbal autopsy (VA) from the Population Health Metrics Research Consortium (PHMRC) and the social autopsy from the Child Health Epidemiology Reference Group (CHERG) (NPC & ICF, 2014). The survey or questionnaire was administered in English but were translated into three main languages (Igbo, Yoruba, and Hausa) (NPC & ICF, 2014). Prior to the enrollment of the participants and interview sessions, ethical clearance was approved by two institutional review boards in Nigeria: The National Health Research Ethics Committee (NHREC) of the Federal Ministry of Health (FMOH) and the United States' Johns Hopkins Bloomberg School of Public Health (JHSPH) Baltimore, Maryland.

Archival or Secondary Data

The 2014 VASA data was the resource for my study's analysis. Access to the 2014 VASA data was obtained via the public domain. Since the data source is open to the public, the published dataset only contained de-identified information (NPC & ICF, 2014). It also means that a written request for the 2014 VASA data access or use to NHREC of the FMOH and United States' JHSPH was not necessary. However, a written request for data use permission and ethical clearance from the Walden University was requested.

The 2014 VASA questionnaire was developed by CHERG, JHSPH, and WHO/UNICEF (NPC & ICF, 2014). The 2014 VASA survey was implemented for the VASA study by the NPC of Nigeria (NPC & ICF, 2014). The questionnaire was reviewed by multiple stakeholders by assessing the relevance of the causes of the biological, social, and behavioral determinants associated with infant mortality cases in Nigeria (NPC & ICF, 2014). The 2014 VASA study or survey was funded by the United States Agency International Development (USAID) (NPC & ICF, 2014).

Similarly, CHERG also developed the 2013 NDHS (NPC & ICF, 2014). The NPC of Nigeria was supported by the UNICEF/WHO to implement the NDHS, and its application and use in many other studies as well (NPC & ICF, 2014). The 2013 NDHS questionnaires were administered to the eligible and selected participants or households were categorized into the Woman's Questionnaire, Man's Questionnaire, and Household Questionnaire. Eligible households accounting to 3,254 samples were evaluated (NPC & ICF, 2014). Women ages 15-49 years old from North and South zones of Nigeria and who lost at least one child under the age of 5 years old and within 5 years preceding the 2013 NDHS were interviewed (NPC & ICF, 2014). The 2014 VASA data collection used two integrated questionnaires (NPC & ICF, 2014). The verbal autopsy questionnaire developed by the PHMRC and social autopsy questionnaire developed by the CHERG agencies were used in the VASA study.

The variables used in the 2014 VASA data collection included variable with a variety of levels of measurements such as scale, nominal or categorical or dichotomous measures. IM construct in terms of its' levels of measurement was operationally defined in a binary level representing only one of the possible outcomes: infant death or no infant death. The complete 2014VASA dataset was exported into the Statistical Package for Social Sciences (SPSS) software where the necessary coding was performed. For coding purposes, the DV IM or infant death variable was represented with the value zero (0) while no infant death or survival was represented with the value one (1) for the study analysis. The first research question's IV, SBA presence was coded with the value 0 and the SBA absence was coded with the value 1. The second research question's IV, the prenatal care was coded with the value 0 and no prenatal care was coded with the numerical value 1. Finally, the third research question's IV, the provider of prenatal care- health facility provider was coded with the value 0 while the traditional provider was coded with the value of 1. Similarly, the selected covariates or confounders such as diabetes, hypertension, and education were coded as well. Women with diabetes were coded with a value 0 and those with no diabetes was coded with the numerical value 1. Also, women with hypertension were coded with a value 0 and those with no hypertension were coded with value of 1. Education levels were grouped into three categories: no education (coded as 0), primary education (coded as 1), and secondary education plus (coded as 2).

The codes used in the SPSS has no quantifiable meaning but rather it is only applied to easily identify cases but not as a measurement quantification scale purpose.

The interviewers used for the 2014 data collection were trained by the NPC staff to administer the questionnaires – the VASA survey to the eligible sampled household representatives (NPC & ICF, 2014). The interviews were compiled on netbook computer (NPC & ICF, 2014). The neonatal death count recorded was 723, which composed of 499 deaths in the northern and 224 in the southern region of Nigeria as recorded in the 2014 VASA dataset (NPC & ICF, 2014). Also, for content validity and data verification, an expert pediatrician reviewed the interviewers' recorded data and assessed the appropriateness of the self-reported diagnosis of the biological attributable causes of the infant deaths (NPC & ICF, 2014). The other method used to analyze the 2014 VASA data was a computer-generated diagnostic algorithm for causes of death, which was arranged in a hierarchy order (NPC & ICF, 2014). The operationalized definition of the infant mortality in this study is the deaths of infants under 1 year old. Likewise, the health facility was operationalized as a medical delivery facility with the presence or absence of the SBA.

Data Analysis Plan

The SPSS software version 23 was used for the statistical analysis. SPSS contains a variety of statistical tests. Descriptive analysis was performed accordingly to describe the frequency and counts of selected study variables described above Frequency was used to represent nominal variable such as IM (cases or no cases) or ordinal variable such as education level (no education, primary education, and secondary education) distribution pattern via a table format and figure or charts. IM cases, SBA presence or absence, prenatal care or no care, provider of prenatal care (health facility and traditional provider) was represented descriptively using frequency distribution and charts. Women with high blood pressure or no high blood pressure (hypertension or no hypertension), educational level, and diabetes were also presented using frequency and charts.

The type of graphs or charts used to represent the variables of interest depends on the variable's level of measurement. For example, the coded dependent variable (IM or infant death) was coded as zero (0) or one (1) for no infant death' or 'survival is a nominal and mutually exclusive variable. The use of binary logistic regression requires the dependent outcome level of measurement to be expressed as a nominal or categorical variable (Forthofer, Lee, & Hernandez, 2007). The independent variable health facility or home-based delivery is also mutually exclusive and a nominal variable, which fits the binary logistic regression assumption (the IV level of measurement can either be a categorical or nominal or continuous variable).

In this current study, predetermined statistical power of 80% and beta (Type II error) of 20% will be used. Also, predetermined 95% (0.95) confidence level and 5% (0.05) alpha (Type I error) were used as the basis of the inferential analysis to determine the statistical significance of the relationships between IM in health facility with the presence or absence of SBA, prenatal care or no prenatal care, and providers of prenatal care (health facility provider and traditional provider). Similarly, inferential analysis to determine the statistical significance of the effects of each of the specified predictor variables identified in each research question was explored further with each of the confounders or covariate included in the regression model as well.

The confounders and covariates must be considered in this current study in order to reduce and limit spurious errors and biases. The covariates or confounders of interest for this current study identified in the VASA data include high blood pressure or hypertension, diabetes, and education level. All these factors have been previously demonstrated to influence IM mortality and maternal mortality as well (Lawn et al., 2014; Singh et al., 2014; UNIGCME, 2015). It is possible that uncontrolled confounding variables distort the findings, which may have created both internal and external validity issues (Brownson, Gurney, & Land, 1999). Internal or external validity issues occur when the IV or DV is compromised by confounders or covariate effects.

The result in terms of statistical significance or lack of significance was interpreted on the basis of whether the estimated p-value wass less than or greater than the predetermined alpha value. The risk of the IM occurrence in the presence or absence of the independent variables (health facility delivery or home delivery with the presence of SBA) was quantified using the odds ratio (*OR*) estimation. When the p-value is less than 0.05 ($p < 0.05$), the null hypothesis was rejected, but when the estimated p-value is greater than 0.05 ($p > 0.05$), the null hypothesis was not be rejected (fail to reject the null hypothesis). For the risk assessment, when the *OR* value is 1.00, it means there is no difference in the risk between the exposed and non-exposed. When the *OR* value is less than 1.00, then the exposure (IV) is protective or has a negative relationship effect on IM. But when the *OR* value is greater than 1.00, then the exposure or IV has a positive relationship effect on the outcome, in this case the IM. For instance, the rejection of the null hypothesis means that IM is either significantly associated with health facility delivery with the presence of SBA compared home-delivery with the presence of SBA at delivery or vice versa. On the other hand, rejection of the null hypothesis means that IM in health facility with the presence of SBA is not statistically significant compared to the infant deaths in home-delivery under the supervision of SBA during childbirth.

Research Questions and Hypotheses

RQ1: What is the difference in risk between IM in health facility for infant delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA?

$H_0$1: There is no difference in risk between IM in health facility for infant delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA.

H_a1: There is difference in risk between IM in health facility for infant delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA.

RQ2: What is the difference in the risk of IM between infants born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy?

$H_0$2: There is no difference in the risk of IM between infants born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy.

H_a2: There is difference in the risk IM between infants born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy.

RQ3: What is the difference in the risk IM between infants born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the infant delivery in the health facility?

$H_0$3: There is no difference in the risk of IM between infants born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the infant delivery in the health facility.

H_a3: There is difference in the risk IM between infants born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the infant delivery in the health facility.

Threats to Validity

Reporting validity of an empirical study should include information on internal and external validity (Steckler & McLeroy, 2008; Kahn, Tollman, Garenne, & Gear, 1999). As observational study lacks manipulation of the exposure or predictive variable of the outcome (Steckler & McLeroy, 2008). Reliability and consistency of the processes and procedures, such as sampling selection and selection bias may affect the validity of the study (Steckler & McLeroy, 2008). For this current study, the known factors implicated with internal and external validity were discussed in detail in this section. Solutions that addressed the identified internal and external validity were discussed as well.

External Validity

External validity is the extent to which study outcomes can be replicated and generalized to other settings or populations using the same procedural measures (Gibbert et al., 2008; Steckler & McLeroy, 2008). The threats to external validity identified in this current study includes sampling, specificity of variables, consistency of interview process, and instrumentations, and steps taken to address reliability and consistency issues. The following are some approaches applied in the 2014 VASA data collection process to address possible internal validity in this study: The 2014 VASA data sampling approach of households was a randomized selection of nationally representative of eligible participants (women 15-49 years old that lost a neonate or childhood within 3-5 years preceding the 2013 NDHS study) from the northern and southern geopolitical zones in Nigeria (NPC & ICF, 2014). However, the predictive factor was not randomly assigned to the representative sample. Thus, spatio-temporal predictions are not possible in this analysis. Therefore, caution should be exercised when implying generalization and causality cannot be implied, rather the conclusion made was limited to correlational effect and on within the target population selected in this current study.

Interviewing of participants may lack consistency due to variations in participants or interviewers' characteristics. The role of personal characteristics, interview method, and the type of the procedural training provided to the interviewer may have influenced the outcomes of interview. Consistency in training across interviewers reduces interviewers or researchers' bias. Inconsistent interview method may influence participants' responses to questions and thus, distorts the findings of the study, and perhaps create a Type I or II error. To adjust for potential interviewer's characteristics effects, eligible interviewers or observers were given thorough training, which included pre-test and post-test evaluations (NPC & ICF, 2014). Pilot fieldwork supervision on interviewers was enforced (NPC & ICF, 2014). Best processes and practices were applied in training eligible candidates or interviewers in the 2014 VASA study and data collection approaches in administering the survey questionnaire to the participants (NPC & ICF, 2014). For example, the eligible interviewer candidacy were graduates with at least a masters' degree. Candidates were given a three-week training, oral and written tests, mock interview between peers, and supervised pilot-test interview with eligible mothers (NPC & ICF, 2014). Remedial study was provided to candidates for improvement (NPC & ICF, 2014). Inconsistency of method by the interviewers or individuals with difficulty at fieldwork was corrected and addressed by the field-coordinator (NPC & ICF, 2014).

Internal validity

Internal validity addresses potential confounders influencing the outcomes other that the intended primary predictor variable under investigation (Gliem & Gliem, 2003; Drost, 2011). The level of internal consistency and reliability of the instrument, design, and sample method applied in a study defines the quality of the approach (Steckler & McLeroy, 2008; Drost, 2011). There are several statistical tools used in assessing validity and reliability. For example, the Cronbach's alpha is important in assessing the reliability of a scale instrument (Gliem & Gliem, 2003). On the other hand, construct validity instrument evaluates the integrity of the operational definition of the construct (Drost, 2011; Mann, 2003; Gliem & Gliem, 2003). An instrument that fail to measure the operational construct accurately will produce a spurious error. The 2014 VASA data collection instruments used in operationalizing the construct validity of IM are the interview approach and self-reported responses (NPC & ICF, 2014).

One barrier to internal validity in this current study is the source of data type. The 2014 VASA data collection instrument used existing tools. Therefore, the secondary data source was no tailored to specific communities in Nigeria or culturally appropriate targets within a variety of diverse communities to which it was used. Hence, the level of the content validity of the instruments including the questionnaire lacked completeness of tailored cultural competency components. Another challenge to internal validity is the sampling method used (Drost, 2011; Mann, 2003; Gliem & Gliem, 2003). The 2014 VASA data collection used was a non-probability method which involves stratified random selection (NPC & ICF, 2014). The random selection did not involve a random assignment of the participants, an approach which is inherent in non-experimental studies (Mann, 2003). Statistical validity is the process through which a researcher forms a reasonable conclusion about the relationship between predictor and outcome variables based on the level of significance (Steckler & McLeroy, 2008). Threats to statistical conclusion validity may occur and could be influenced by inadequate statistical power, sample size, effect size, and validity of measurement (Steckler & McLeroy, 2008).

Ethical Procedure

The NHREC of the FMOH and JHSPH's institutional review board (IRB) approved the proposal to conduct the 2014 VASA survey or study (NPC & ICF, 2014). The VASA study was also extended to 2015 for completeness and approval (NPC & ICF, 2014). The 2014 VASA study consent approval number is Q1332B (NPC & ICF, 2014). Informed consent was given to all the participants prior to the start of the interview (NPC & ICF, 2014). The consent was approved for the 2014 VASA questionnaire for use in an interview of eligible households' participants (NPC & ICF, 2014). The sample for the 2014 VASA was modified to avoid the burden of repeated interviews and overlap of the same health risks and social determinants (NPC & ICF, 2014).

Ethical consideration limiting emotional burden of recalling the death of a child under the age of 5 years within a household was considered carefully on how to deal with the situation during the interview process. For this reason, counseling approaches were implemented and employed in cases where it is needed (NPC & ICF, 2014). Overall, the purposes of VASA data collection were to estimate possible biological indicators and social or environmental determinants of neonatal and child death in Nigeria (NPC & ICF, 2014). There is substantial lack or inadequate of child death-certificate confirming the cause(s) of under-5 mortality in Nigeria (Adewemimo et al., 2017; Akinyemi et al., 2013; Chinawa et al., 2015; Ekwochi et al., 2017; Koffi et al., 2017; Lawn et al., 2014). Also, the verbal autopsy interview was conducted to assess the attributable risk factors or indicators of deaths following signs and symptoms identified during the interview process (Adewemimo et al., 2017; NPC & ICF, 2014).

Summary

The use of a quantitative method and cross-sectional design aligns with the posed research questions. The assessment of the prevalence, incidence, and risk of an outcome are commonly explored using a cross-sectional design. Also, the use of secondary data to address quantitative research questions is an alternative approach when the feasibility of conducting a primary research is not possible. The application of a binary logistic regression for the analysis of the posed research questions is also fitting as described earlier. The areas covered in the methodology section of this dissertation lays the foundation through which the results in chapter 4 and interpretation of the result in chapter 5 were formulated.

Chapter 4: Results

Introduction

My goal was to investigate the association between risk factors such as SBA, prenatal care, and prenatal care providers and IM among women in Nigeria who delivered an infant in a health facility. Each risk factor was analyzed separately to address the corresponding research questions. The goal is to show whether any association exits between each factor and IM. The research questions and hypotheses that were addressed are as follows:

Research Questions and Hypotheses

RQ1: What is the difference in risk between IM in health facility for child delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA?

$H_0$1: There is no difference in risk between IM in health facility for child delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA.

H_a1: There is difference in risk between IM in health facility for child delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA.

RQ2: What is the difference in the risk of IM between children born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy?

$H_0$2: There is no difference in the risk of IM between children born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy.

H_a2: There is difference in the risk of IM between children born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy.

RQ3: What is the difference in the risk of IM between children born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the child delivery in the health facility?

$H_0$3: There is no difference in the risk of IM between children born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the child delivery in the health facility.

H_a3: There is difference in the risk of IM between children born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the child delivery in the health facility.

Data Collection

I used 2014 VASA secondary data for this analysis. VASA staff collected the data directly from the human subjects via a survey. After approval of my IRB process, I requested access to the 2014 VASA data by contacting authorized personnel via email. Upon approval of the data access request, VASA authorized staff emailed a protected 2014 VASA data set for this study. The minimum estimated sample size to generate a statistical power of 80% in this study was 70 participants. In this study, I used a total of 248 participants for the statistical analysis, which was the number of participants reported in the 2014 VASA data with complete information out of 723 participants surveyed for IM cases. Details on how VASA collected the 2014 data was described in Chapter 3.

Results

The focus of this study was to assess the effects of SBA, prenatal care, and prenatal care providers on IM among women in Nigeria who delivered an infant in a health facility. In Table 1, the DV (IM), IV's (SBA, prenatal care, and prenatal care providers), and confounders (education, hypertension, and diabetes) were the key test variables included in the analysis.

Table 1

Study Variables and Variable Type

Variables	**Variable Types**
IM	Dependent Variable
SBA	Independent Variable
Prenatal Care	Independent Variable
Providers of Prenatal Care	Independent Variable
Education	Confounder
Hypertension	Confounder
Diabetes	Confounder

Descriptive Analysis

Table 2 represents the distribution of IM status, SBA, prenatal care, providers of prenatal care, education level, hypertension, and diabetes variables in the rows. The table columns show the test variables distribution, total participants, alive infants, and dead infants, cases. The total number of infants reported in the VASA data was 723. Of 723 infants, the mortality status on 475 (65.7%) infants were not reported (system missing) with incomplete survey information. Of 248 (34.3%) with complete survey information, 88 (35.5%) infants were delivered alive and 160 (64.5%) died during or after delivery in the health facility. As a result, the sample size of infants that were included in this statistical analysis was 248. Participants with missing data were described in the descriptive portion of the analysis but were excluded from the inferential analysis.

Table 2

Dependent and Independent Variables Case Load Distribution

Variable	Total	Alive	Dead
IM	248	88	160
SBA	241	87	154
No SBA	7	1	6
Prenatal Care	228	79	149
No Prenatal Care	20	9	11
Providers Prenatal Care			
Health Facility	220	79	141
Traditional	8	0	8
Education Level			
No Educational Level	31	18	13
Primary Education	76	26	50
Secondary Education	130	40	90
Hypertension	19	7	12
No Hypertension	229	81	148
Diabetes	1	0	1
No Diabetes	247	8	159

Inferential Analysis for the Research Questions and Hypotheses

The following RQs and hypotheses were addressed inferentially in this current study based on the following predetermined statistical measures:

- *p-value* or significance value = 0.05 or 5%.
- Confidence intervals of 0.095 or 95%
- Effect sizes of 2.5%.
- Minimum sample size of 70.

Research Question 1 Inferential Analysis:

Effects of SBA (Received SBA vs No SBA) on IM

RQ1: What is the difference in risk between IM in health facility for infant delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA?

$H_0$1: There is no difference in risk between IM in health facility for infant delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA.

H_a1: There is difference in risk between IM in health facility for infant delivery with the assistance of SBA compared to IM in health facility delivery with no assistance from SBA.

Table 3 is the model summary representing SBA prediction of IM. The Cox and Snell *R* square model showed that only 0.7% of the IM could be explained by SBA without accounting for education level, hypertension, and diabetes in this study. On the other hand, the Nagelkerke *R* square model suggested that 0.9% of IM outcomes could be explained by SBA.

Table 3

Model Summary for RQ1

tep	-2 Log likelihood	Cox & Snell *R* Square	Nagelkerke *R* Square
1	320.964[a]	.007	009

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

The classification table for the predicted effect of SBA on IM outcomes is shown in Table 4. The predictive cut value for this analysis was set at 0.500, indicating that the probability of IM outcomes for infant death cases is greater than 0.500. Also, percentage accuracy, sensitivity, specificity, positive predictive value, and negative predictive value were estimated in Table 4. The cases that were correctly classified as no IM when women without SBA were added in the model were represented with percentage accuracy. The sensitivity is the percentage of IM cases. The specificity represents the percentage of no IM cases. The positive and negative predictive values are the percentages of correctly predicted cases for IM or no IM compared to the total number of cases.

Table 4

Classification Table for RQ1

	Predicted		
	IM		Percentage
Observed	Alive	Dead	Correct

Step 1	IM	Alive	0	88	.0
		Dead	0	160	100.0
	Overall Percentage				64.5

a. The cut value is .500

Using women who had SBA during delivery as the reference group, the reported IM outcome between women who did not have SBA service is represented as follows**;** *β = 1.221, W(1) = 1.258, OR = 3.390, p = 0.262, 95% CI [0.402, 28.616]* (Table 5). Based on the information, SBA status is not a risk factor of IM. IM outcomes among women who delivered an infant in the health facility without the presence of SBA is not statistically significant compared to women who delivered an infant with the assistance of SBA (*p = 0.262)*. However, women without the assistance of SBA during delivery has higher risk (*OR = 3.390*) of IM outcomes compared to those with assistance of SBA during delivery.

Table 5

Variable in the Equation for RQ1

								95% C.I. for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	No SBA	1.221	1.088	1.258	1	.262	3.390	.402	28.616
	Constant	.571	.134	18.129	1	.000	1.770		

Effects of Prenatal Care (Received Prenatal Care vs No Prenatal Care) on IM

RQ2**:** What is the difference in the risk of IM between infants born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy?

$H_0$2: There is no difference in the risk of IM between infants born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy.

H_a2: There is difference in the risk of IM between infants born by women who received prenatal care during the pregnancy period compared to infants delivered by mothers who did not receive prenatal care during the duration of their pregnancy.

Table 6 is the model summary representing prenatal care prediction of IM. The Cox and Snell R square model showed that only 0.3% of the IM could be explained by prenatal care without accounting for education level, hypertension, and diabetes. On the other hand, the Nagelkerke R square model, suggested that 0.5% of IM outcomes could be explained by prenatal care.

Table 6

Model Summary for RQ2

Step 1	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
	321.758[a]	.003	.005

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

The classification table for the predicted effect of prenatal care on IM outcomes is shown in Table 7. The predictive 'cut value' for this analysis was set at 0.500, indicating that the probability of IM outcomes for 'infant death' cases is greater than 0.500. Also, percentage accuracy, sensitivity, specificity, positive predictive value, and negative predictive value were estimated in Table 7. The cases that were correctly classified as no IM when women without prenatal care were added in the model were represented with percentage accuracy. The sensitivity is the percentage of 'IM' cases. The specificity represents the percentage of no IM cases. The positive and negative predictive values are the percentages of correctly predicted cases for IM or no IM compared to the total number of cases.

Table 7

Classification Table for RQ2

			Predicted		
			IM		
	Observed		Alive	Dead	Percentage Correct
Step 1	IM	Alive	0	88	.0
		Dead	0	160	100.0
	Overall Percentage				64.5

a. The cut value is .500

Using women who had prenatal care during pregnancy as the reference group, the reported IM outcome between women who did not have prenatal care is represented as follows**;** *β = -0.434, W(1) = 0.850, OR = 1.543, p = 0.357, 95% CI [0.614, 3.881]* (Table

8). Based on the information, prenatal care status is not a predictor of IM even without accounting for education level, hypertension, and diabetes. IM outcomes among women who delivered an infant in the health facility with prenatal care is not statistically significant compared to women who delivered an infant without prenatal care during the pregnancy period (*p = 0.357).* However, women with prenatal care during pregnancy has lower risk (*OR = 1.543*) of IM outcomes compared to those without prenatal care during pregnancy.

Table 8

Variable in the Equation for RQ2

								95% C.I. for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Prenatal Care	-.434	.471	.850	1	.357	1.543	.614	3.881
	Constant	.201	.449	.199	1	.655	1.222		

a. Variable(s) entered on step 1: Prenatal Care.

Effects of Providers of Prenatal Care (Received Prenatal Care from a Health Care Facility vs Traditional Prenatal Care Providers) on IM

RQ3: What is the difference in the risk of IM between infants born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the infant delivery in the health facility?

$H_0 3$: There is no difference in the risk of IM between infants born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the infant delivery in the health facility.

$H_a 3$: There is difference in the risk of IM between infants born by mothers who received prenatal care services from health facility during their pregnancy period compared to those who were born by mothers who were provided prenatal care by a traditional provider during their pregnancy period and before the infant delivery in the health facility.

Table 9 is the model summary representing providers of prenatal care prediction of IM. The Cox and Snell R square model showed that only 3.0% of the IM could be explained by providers of prenatal care without accounting for education level, hypertension, and diabetes in this study. On the other hand, the Nagelkerke R square model, suggested that 4.1% of IM outcomes could be explained by providers of prenatal care.

Table 9
Model Summary for RQ3

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	287.273[a]	.030	.041

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

The classification table for the predicted effect of providers of prenatal care on IM outcomes is shown in Table 10. The predictive 'cut value' for this analysis was set at 0.500, indicating that the probability of IM outcomes for 'infant death' cases is greater than 0.500. Also, percentage accuracy, sensitivity, specificity, positive predictive value, and negative predictive value were estimated in Table 16. The cases that were correctly classified as no IM when women without health provider care during pregnancy duration were added in the model were represented with percentage accuracy. The sensitivity is the percentage of 'IM' cases. The specificity represents the percentage of no IM cases. The positive and negative predictive values are the percentages of correctly predicted cases for IM or no IM compared to the total number of cases.

Table 10

Classification Table for RQ3

			Predicted		
			IM		
	Observed		Alive	Dead	Percentage Correct
Step 1	IM	Alive	0	79	.0
		Dead	0	149	100.0
	Overall Percentage				65.4

a. The cut value is .500

Using women who were provided prenatal care during pregnancy by health care providers as the reference group, the reported IM outcome between women who were provided prenatal care by traditional providers is represented as follows**;** *β = -20.624, W(1) = 0.000, OR < 0.001, p = 0.999, 95% CI [0.000, 0.0]* (Table 17). Based on the information, without accounting for education level, hypertension, and diabetes, providers of prenatal care (health facility or traditional providers) is not a predictor of IM. IM outcomes among women who delivered an infant in the health facility with prenatal care provided by traditional provider is not statistically significant (*p = 0.999)* compared to women who delivered an infant who had prenatal care from a health facilty during the pregnancy period. However, women with prenatal care provided by traditional providers during pregnancy has lower risk (*OR < 0.001*) of IM outcomes compared to prenatal care provided by health facility during pregnancy.

Table 11

Variable in the Equation for RQ3

								95% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Traditional Providers	-20.624	14210.4	.000	1	.999	.000	.000	.0
	Constant	21.203	14210.4	.000	1	.999	1615475297.0		

a. Variable(s) entered on step 1: Providers of Prenatal Care.

Accounting for Confounding for RQ1

There is no need to account for confounding because none of the primary research questions' IVs statistically predicted IM when analyzed without accounting for the confounders (education level, hypertension, and diabetes). Nonetheless, I conducted post hoc analysis for research RQ1 only to show that non-significant effect observed with the SBA on IM did not change to a significant outcome after accounting for education, hypertension, and diabetes. Table 11 is the model summary representing prenatal care prediction of IM. The Cox and Snell R square model showed that only 4.4% of the IM could be explained by SBA after accounting for education level, hypertension, and diabetes. On the other hand, the Nagelkerke R square model suggested that 6.0% of IM outcomes could be explained by SBA

Table 12

Model Summary for Confounding Variables for RQ1

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	297.594[a]	.044	.060

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

The classification table for the predicted effect of SBA on IM outcomes after accounting for educational level, hypertension, and diabetes for research question 1 is shown in Table 12. The predictive 'cut value' for this analysis was set at 0.500, indicating that the probability of IM outcomes for 'infant death' cases is greater than 0.500. Also, percentage accuracy, sensitivity, specificity, positive predictive value, and negative predictive value were estimated in Table 12. The cases that were correctly classified as no IM when women who had infant delivery without SBA care were added in the model were represented with percentage accuracy. The sensitivity is the percentage of 'IM' cases. The specificity represents the percentage of no IM cases. The positive and negative predictive values are the percentages of correctly predicted cases for IM or no IM compared to the total number of cases.

Table 13

Classification Table for Confounding Variables for RQ1

			Predicted		
			IM		Percentage
	Observed		Alive	Dead	Correct
Step 1	IM	Alive	15	69	17.9
		Dead	11	142	92.8
	Overall Percentage				66.2

a. The cut value is .500

Using women who were assisted by SBA during infant delivery in health facility as the reference group, the reported IM outcome between women who did not have an SBA during infant delivery is represented as follows**;** *$\beta = 1.111$, $W(1) = 1.035$, OR = 3.036, $p = 0.309$, 95% CI [0.357, 25.797]* (Table 13). Based on the information, after accounting for education level, hypertension, and diabetes; SBA (SBA presence or No SBA presence) is not a predictor of IM. IM outcomes among women who delivered an infant in the health facility with the assistance of SBA is not statistically significant compared to women who delivered an infant without the assistance of SBA (*p = 0.309)*. However, women without SBA during infant delivery has higher IM outcome risk (*OR = 3.036*) compared to woman who delivered an infant in health facility with a SBA. It shows that women with primary education level significantly (*p = 0.006*) influenced IM cases when compared to those with no education in the presence of SBA in delivery. The effects of secondary/higher education, hypertension, and diabetes were not significant.

Table 14

Variable in the Equation for Confounding Variables for RQ3

								95% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	No SBA	1.111	1.092	1.035	1	.309	3.036	.357	25.797
	No Education			7.678	2	.022			
	Primary Education	-1.154	.419	7.595	1	.006	.315	.139	.717
	Secondary/Higher Education	-.154	.309	.248	1	.619	.857	.468	1.571
	Hypertension	.483	.584	.683	1	.409	1.620	.516	5.090
	Diabetes	-19.971	40193.049	.000	1	1.000	.000	.000	.0
	Constant	20.720	40193.049	.000	1	1.000	997105536		

a. Variable(s) entered on step 1: SBA, Education Level, Hypertension, Diabetes.

Summary

The effects of three independent variables-SBA, prenatal care, and providers of prenatal care on IM outcomes were explored in this study. Descriptive analyses were conducted to describe the distribution pattern, frequency and counts of the women who received SBA during infant delivery, prenatal care during pregnancy, and assess the entity who provided the prenatal care. Following the descriptive evaluation, an inferential analysis was conducted for the three research questions without accounting for education level, hypertension, and diabetes. Education level, hypertension, and diabetes were accounted for in research question 1 analysis.

For RQ1, IM cases among women who received SBA were compared to those who did not receive SBA during infant delivery. Without accounting for education level, hypertension, and diabetes, SBA absence during infant delivery was not a predictor of IM outcomes when compared to SBA presence. After accounting for education level, hypertension, and diabetes, women who did not received SBA during infant delivery still did not significantly predict IM outcomes compared to women who received SBA during infant delivery.

For RQ2, IM cases among women who received prenatal care were compared to those who did not receive prenatal care during pregnancy. Without accounting for education level, hypertension, and diabetes, no prenatal care services during pregnancy was not a predictor of IM outcomes when compared to women who had prenatal care. When the analysis was conducted with only IM and prenatal care, the analysis was not statistically significant. Hence, no further post hoc analysis was needed to account for education level, hypertension, and diabetes.

For RQ3, IM cases among women who received prenatal care by health care providers were compared to those who received prenatal care during pregnancy by traditional providers. Without accounting for education level, hypertension, and diabetes, traditional prenatal care provider was not a predictor of IM outcomes when compared to health care provider of prenatal care. When the analysis was conducted with only IM and providers of prenatal care, the analysis was not statistically significant. Hence, further post hoc analysis was not needed to account for education level, hypertension, and diabetes. The interpretation of the study findings and conclusion was discussed in Chapter 5 below.

Chapter 5: Conclusions

Introduction

The association between SBA, prenatal care, and providers of prenatal care was explored regarding its individual effect on IM for birth delivery at health facilities in Nigeria. For this analysis, SBA factor was grouped into presence of SBA or absence of SBA during labor/delivery. Prenatal care was grouped into prenatal care or no prenatal care. Similarly, prenatal care provider was grouped into ‘health facility provider or traditional care provider. The nature of the study is a correlational inference, not a causal association because the study design was a cross sectional approach. Chapter 5, includes the introduction, interpretation of the findings, limitations of the study, recommendations, implications, and conclusion.

Interpretation of the Findings

In this study, the alpha value (Type I error [5%]), confidence level [95%], beta (Type II error [20%]), statistical power (80%), and odds ratio or effect size (2.5) were predetermined as the inferential reference or test statistics to estimate the *p*-values or significant values and calculate odds ratio. The specified reference values or test statistics were used for the interpretation of RQ 1, 2, and 3, and the associated hypotheses. RQ1possed to evaluate the effect of SBA presence or absence at birth delivery in Nigerian-based health facilities, produced an odds ratio value of 3.39 and *p*-value of 0.262. The results suggested that in Nigeria, among the selected health facilities and target population, infant death among mothers who had infant delivery in health facilities without the assistance of the SBA is over three time (*OR* = 3.39) likely to have

IM cases than among women who delivered with the assistance of SBA. However, the odds ratio or magnitude of effect was not statistically significant, $p = 0.262$. Based on the estimated *p*-value = 0.262, the null hypothesis for RQ1 was not rejected.

In terms of *OR* estimations, these current study findings were different from Fink et al. (2015) who estimated an adjusted odds ratio (a*OR*) of 0.995 for the assessment of the effects of the skilled-childbirth provision in health facility on IM in middle and low-income countries. Fink et al. (2015) also supported no statistically significant association between SBA and IM. On the other hand, some studies support increased risk of IM ($p = 0.01$) with SBA presence at infant delivery in health facility in developing countries (see Cheelo et al., 2016; Liambila et al., 2014; Singh et al., 2014; Stanley et. al, 2016). In Bangladesh, a study shows positive relationship between SBA-assisted delivery and IM reduction (Islam et al., 2014). The findings were contrary to the estimation I found.

RQ2 was posed to assess whether prenatal care or no prenatal care service predicted IM. The estimation shows that prenatal care did not predict IM ($p = 0.357$, 95% *CI* [0.614, 3.881]) with calculated *OR* value of 1.543. *OR* value of 1.543 suggests that women who received prenatal care during the duration of their pregnancy are one and a half times prone to higher risk of IM compared to women who did not receive prenatal care. With estimated *p*-value of 0.357, prenatal care did not significantly predict IM within health facility delivery. Hence, I failed to reject the null hypothesis.

This current finding on prenatal care on IM is supported by Singh et al. (2014) study, which shows women who received prenatal care and have SBA-assisted childbirth in health facility in Asia and Africa have higher prevalence of IM compared to those in

Latin America or Caribbean. The VASA study conducted in Cameroon found 63% out of 64 infants born to mothers who delivered in health facility died before leaving the health institution (Koffi et al., 2015). In contrary, a researcher found positive correlation between prenatal care of four or more services reduced IM (*p*-value < 0.001, *OR* 0.21; 95% *CI* 0.12 – 0.35) compared to those who did not receive prenatal care (Kayode et al., 2014). Based on the finding s of this study, uncertainty still exist on the effect of prenatal care on IM among pregnant women in Nigeria who delivers a child in a health facility.

RQ3 was designed to assess whether there is an association between health facility provider compared to traditional provider to the risk of IM in the place of delivery. Based on the analysis, I found that there is no difference in IM between women who were provided prenatal care by the health facility provider compared to those who received prenatal care by a traditional provider. IM cases among mothers who received traditional provider prenatal care was not statistically significant, $p = 0.999$, 95% *CI* [0.000, 0.0], *OR* < 0.001. Based on the *p*-value (0.999), which isgreater than the predetermined alpha value (0.05), the null hypothesis was not rejected. However, Afulani et al. (2016) found a positive association between health facility prenatal care provider and increased infant survival (lower odds of infant death) compared to women who received traditional prenatal care.

For the application of Mosley and Chen (1984) proximate variable to this study, the proximate variable that is categorized in five groups can be interpreted as follows. Regarding environment contamination, health facility infrastructure and physical environment pose a potential source of contamination to infant survival. Inadequate supplies and technology, poor sanitation, and water supply were linked to IM in Tanzania, a phenomenon common to other SSA countries such as Nigeria (Singh et al., 2014). The type of quality of care provided by SBA may be affected by the environmental status and the care that mothers receive during intrapartum care in health facility environment (Singh et al., 2014). Leslie et al. (2016) found in Malawi that top 25% of high performing health facility deliveries showed positive association (p = 0.047) with infant death reduction compared to low-performing health facility systems.

The personal illness control variable may be represented as the prenatal care received by mothers from the health facility provider compared to prenatal care by traditional provider. My findings showed the risk of IM is higher among infants whose mothers received health facility prenatal care compared to those who received prenatal care from traditional providers. This may be interpreted to the social and cultural barriers deferential such as access to care, transportation, and/or cost that may impede adequacy of prenatal visits to health facility provider (Kananura et al., 2016).

The maternal characteristics and biological mechanism refers to the characteristic pertinent to the mother such as age, birth interval, and parity (Mosley & Chen, 1984). Maternal age may influence pregnancy care and the understanding of infant care education (NPC & ICF, 2014). In this study, education level was grouped into three categories (no education, primary education, and secondary education or higher). Based on my findings, women who received primary education statistically predicted IM compared to those that had no education.

The construct of injury proximate determinant represents the IM outcome in this study. The injury variable was used to explain IM or infant death cases in this current study. The IM or infant death variable was grouped into IM or alive, which is mutually exclusive. As shown in Table 2 above, the distribution of IM or the death cases was 64.5% compared to those that survived, which was 35.5%. Of 723 respondents, VASA recorded a total of 248 infants (the total of those that survived and those that died) in health facility (NPC & ICF, 2014). Four hundred and seventy-five cases were missing (NPC & ICF, 2014).

The nutrient deficit proximate variable represents a biological indicator, for instance, protein, calorie, and other nutrient intake that play a crucial role in mother's and infant health status. Nutritional factor could influence mother's weight status during pregnancy, consequently, infant size, and other intrinsic or extrinsic pregnancy factors, that may influence infant size and health status (Mosley & Chen, 1984). In this study, nutritional risk was not measured.

Limitations of the Study

There are multiple limitations in the study that impacted inability to generalization of this study. In the Mosley and Chen (1984) framework, social factors which were not accounted for such as access to health insurance coverage may not reflect the sociocultural environment in Nigeria. Therefore, suboptimal environment may affect the IM outcome (Mosley & Chen, 1984). Furthermore, where universal health coverage for maternal care is found inadequate, for example, the vulnerable women (those who live in rural area or poor income-households) are unlikely to seek maternal preventive and curative measures (Agyepong et al., 2017).

Another limitation is the influence of the VASA dataset itself. The 2014 VASA project was the first of its kind in Nigeria to conduct quantitative assessment of IM in health facility (NPC & ICF, 2014). The dataset has large proportion of missing data, which may have altered the study findings. It is possible that the missing records may have impacted the internal validity of the study. The internal validity threat to this research findings may be several factors primarily influencing large proportion missing data from self-reported interview. As a retrospective study, the VASA data lacks real time process on the completeness, appropriateness, and accuracy of review. For example, contextual factors such as culture or participant literacy level may have affected interview response rates. Thus, the contributing factors to the missing IM cases in VASA data were unknown. It is considered a systematic error, which can impact the accuracy and representativeness of the sampled population (Forthofer et al, 2007). Since this was a quantitative-based study, the qualitative and subjective perception of the respondents were not considered. Hence, further research may be needed to explore the perceptive aspects of these risk factors.

Recommendations

Based on the observed limitations observed in this study including large proportion of missing data from the 2014 VASA dataset, I recommend that further study is needed with subsequent VASA data in Nigeria. As such, the finding from this study cannot be generalized to the entire population but must be limited within the target population used in this study. On the individual and family levels, it is rather useful for pregnant women to have a routine check-up with their care provider to enhance health promotion measures and facilitate primary preventative approaches in care. SBA, prenatal care, providers of prenatal care are champions of preventative care and promotion of quality health both in clinical and public health settings. In terms of the organizational or clinical levels, promotion of SBA, prenatal care, and quality providers of prenatal care could reduce the incidence, prevalence, and mortality cases related to maternal and infant adverse health outcomes. It could also promote promotion of population-based quality of life within vulnerable population in Nigeria. Since, there is no significant difference observed SBA, prenatal care, and providers of prenatal care, it is extremely important for all the health facilities in Nigeria to re-evaluate the quality of care provided to pregnant women before and during delivery. It is possible that health facility may use the findings of this study to encourage re-examination of their protocol, practices, and procedures implemented for provision care services. If necessary, the Nigerian ministry of health could also use the findings of this study to promote new or support existing regulation designed to enforce strict adherence to clinical quality measures.

I recommend routine annual vital record audit in health facility in Nigeria for accuracy and upkeep of birth and death record across the nation. The maternal and perinatal death and surveillance reviews (MDSRs) tool applied in Malawian community levels enhanced problem solving to improve obstetric complication risks, and consequently, improved pregnancy outcomes (Hilber, 2016). I also recommend that the

Nigeria Medical Association should continue more than ever to advocate for enhancement of vital records practice in health facilities across the nation to better understand IM risks associated with SBA presence or absence during delivery, prenatal care (presence or absence), and providers of prenatal care (health facility verses traditional provider) as it relates to IM cases in Nigeria. Further research is needed to examine other possible contextual or subjective perception among health facility practitioners, SBAs, traditional providers, and patients about health facility related IM cases in Nigeria.

Implications

This finding provided additional information to the public health discipline on the need to support more inquiries to address large proportion IM factor as a public health issue in Nigeria. Therefore, intense focus should be directed towards examining identifiable other potential risk factors by creating interactive prenatal care and pregnancy surveillance system in Nigeria by the federal ministry of health to decrease adverse outcomes of pregnancy related disparities in multiple geographic areas such as the local, urban communities, and health facility (maternal care centers, maternity community centers) levels in Nigeria. Such approach could substantially improve maternal and child awareness and increase shared knowledge about maternal and infant health across individual, regional, geographic, and cultural levels. The observations found in this study could provide meaningful pregnancy-related linkages and resources to local and urban maternal healthcare centers, health posts, and drug stores in communities across Nigeria.

Conclusion

In this study, the importance to further address the high IM cases is apparent based on no significant relationship between the risk factors (SBA presence or absence during childbirth in health facility; prenatal care or no prenatal care during pregnancy duration; and prenatal care providers [health facility or traditional provider]) and risk of IM or IM outcomes observed in health facility care delivery Nigeria. However, the data analysis shows lower odds ratio for infant death among women who received SBA-assistance during labor and delivery compared to those who did not. Pregnant women who received health facility prenatal care has slightly higher risk of IM compared to those who did not. The traditional provider prenatal care recipients have lower mortality risk compared to their counterparts.

While the study covariates such as education, hypertension, and diabetes were not included in the model because there was no statistically significant different between the predictors and IM, the variables are still meaningful modifiers to consider. For instance, another study shows higher education level was associated with a decline in the risk of IM among mothers who had assisted child delivery by the SBA in health institution and also who received prenatal care during the time of the pregnancy in 1990-2008 in Nigeria (Akinyemi et al., 2013). Furthermore, a study shows an adjusted high odd ratio (AOR): 1.32 (CI 0.95, 1.84) for IM reduction for infants whose mothers had obstetric complication during labor that received SBA assistance in health institution delivery in West Kenya compared to mothers who did not (Liambila et al., 2014).

Bhutta et al. (2014) findings, shows that obstetric complication such as pregnancy induced high blood pressure or hypertension/eclampsia, obstructed labor, and hemorrhage adversely affect IM outcome. Ineffective management of such life-threatening complications during delivery can influence IM for mothers even referred to a higher level of care to a health institution due to the complication (Chaturvedi et al., 2014). However, a systematic review of maternal interventions for a continuum of care (i. e., pregnancy duration, intrapartum event, and post-childbirth) found early detection and treatment of hypertension and obstetric compilations can reduce IM outcome (Bhutta et al., 2014; Chaturvedi et al., 2014). Also, according to another researcher, mothers who receive adequate and quality prenatal care and postnatal services have lower odds (*OR = 0.21; 95% CI 0.120.35; p-value* < *0.001*); (*OR = 0.25; 95% CI 0.13-0.46; p-value* < *0.001*)] of infant death respectively, compared to those who did not receive such treatment (Kayode et al., 2014). SBA provision of interventions for a life-threatening complication during labor and delivery can reduce IM up to 40% according to Bhutta et al. (2014).

Diabetes covariate was explored in this research. The analysis reveals that there is no influence between the risk factors or predictors (providers of prenatal care [health or traditional], prenatal care, and SBA] and IM outcome. But previous study shows diabetes or pregnancy-induced diabetes has an adverse effect on infant risk of mortality or survival (Bhutta et al., 2014). The early detection of diabetes in pregnancy can substantially reduce IM outcome (Bhutta et al., 2014).

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